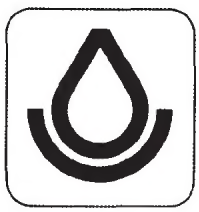
SOIL SURVEY OF

St. Croix County, Wisconsin



United States Department of Agriculture
Soil Conservation Service
In cooperation with
Research Division of the College of Agricultural and Life Sciences
University of Wisconsin

This is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and agencies of the States, usually the Agricultural Experiment Stations. In some surveys, other Federal and local agencies also contribute. The Soil Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all who need the information, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was completed in the period 1969–74. Soil names and descriptions were approved in 1975. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1975. This survey was made cooperatively by the Soil Conservation Service and the Research Division of the College of Agricultural and Life Sciences, University of Wisconsin. It is part of the technical assistance furnished to the St. Croix County Soil and Water Conservation District.

The fieldwork that is the basis for this soil survey was partly financed by the St. Croix County Soil and Water Conservation District.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms and woodlands; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

All the soils of St. Croix County are shown on the detailed map at the back of this survey. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the county in alphabetic order by map symbol and gives the page where each is described. It also shows the capability grouping, woodland group, wildlife group, tree and shrub group, and recreation group in which the soil has been placed.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the discussions of management for crops and pasture and management by capability units.

Foresters and others can refer to the section "Woodland," where the soils of the county are grouped according to their suitability for woodland and landscaping and windbreak plantings.

Game managers, sportsmen, and others can find information about soils and wildlife in the section "Wildlife."

Community planners and others can read about soil properties that affect the choice of sites for dwellings, industrial buildings, and recreation areas in the section "Interpretation of the Soils for Town and Country Planning" and "Recreation."

Engineers and builders can find, under "Engineering," tables that contain test data, estimates of soil properties, and information about soil features that affect engineering practices.

Scientists and others can read about how the soils formed and how they are classified in the section "Formation and Classification of the Soils."

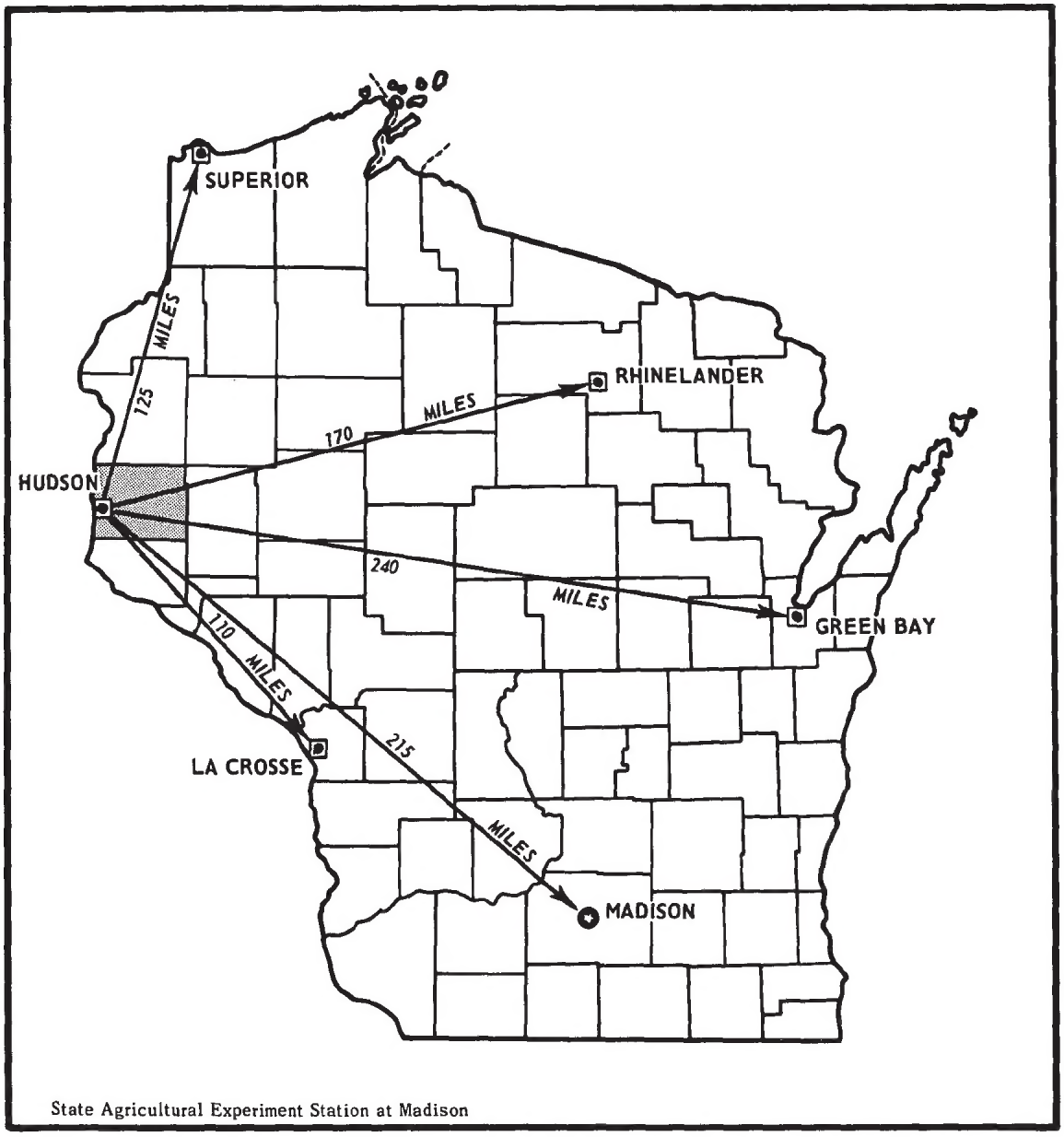
Newcomers in St. Croix County may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the information about the county given in the section "Environmental Factors Affecting Soil Use."

Contents

Issued July 1978

Index to Mapping Units

Summary of Tables



Location of St. Croix County in Wisconsin.

SOIL SURVEY OF ST. CROIX COUNTY, WISCONSIN

BY JOHN E. LANGTON, SOIL CONSERVATION SERVICE

FIELD WORK BY JOSEPH M. BOELTER, DALE E. JAKEL, KEITH H. WIDDEL AND JOHN E. LANGTON, SOIL CONSERVATION SERVICE.

UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE IN COOPERATION WITH THE RESEARCH DIVISION OF THE COLLEGE OF AGRICULTURAL AND LIFE SCIENCES, UNIVERSITY OF WISCONSIN

ST. CROIX COUNTY is in west-central Wisconsin (see opposite page). It is separated from Minnesota by the St. Croix River. The county area is about 736 square miles or approximately 469,760 acres. Hudson, the county seat, is in the extreme western part of the county.

The soils of St. Croix County are mostly loamy and gently sloping or sloping. They are well drained to somewhat poorly drained, and surface drainage is in a southerly direction. Glaciation is chiefly responsible for the many kinds of soils formed. It affected formation of the soils by depositing several kinds of glacial drift and by sculpturing a wide variety of land forms. In most places the glacial drift is many feet thick over bedrock. The bedrock consists mainly of dolomitic limestone.

Most soils in St. Croix County are suited to many different crops. Corn, oats, and alfalfa are the main crops grown, but some truck and canning crops are also grown. Wooded areas are mainly on steep and wet soils. Most of the farm income is from dairying and from livestock and livestock products.

St. Croix County is part of the metropolitan fringe of St. Paul, Minnesota, and much of the western part is in suburban developments. This development has been accelerated by the construction of Interstate Highway 94 through the county.

The increasing demand for food, for homesites, and for industrial, recreational, and transportation facilities makes it important to select suitable soil areas for each intended use. Therefore, this soil survey is designed to provide information useful for community and county planning as well as for farming.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in St. Croix County, where they are located, and how they can be used. The soil scientists went into the county knowing they likely would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes, the size and speed of streams, the kinds of native plants or crops, the kinds of rock, and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Burkhardt and Jewett, for example, are the names of two soil series. All the soils in the United States having the same series are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Burkhardt sandy loam, 6 to 12 percent slopes, eroded, is one of several phases within the Burkhardt series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map at the back of this survey was prepared from aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of

[1] Other soil scientists who assisted in the mapping are Delbert D. Thomas, Gorden N. Wing, Dale E. Parker and Orville L. Haszel.

some other kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series, or of different phases within one series. Two such kinds of mapping units are shown on the soil map of St. Croix County: soil complexes and undifferentiated groups.

A soil complex consists of areas of two or more soils, so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. Generally, the name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Burkhardt-Sattre complex is an example.

An undifferentiated group is made up of two or more soils or miscellaneous areas that could be delineated individually but are shown as one unit because, for the purpose of the soil survey, there is little value in separating them. The pattern and proportion of soils are not uniform. An area shown on the map may be made up of only one of the dominant soils, or of two or more. If there are two or more dominant series represented in the group, the name of the group ordinarily consists of the names of the dominant soils, joined by "and." Ritchey soils and Rock outcrop is an example of an undifferentiated group in St. Croix County.

In most areas surveyed there are places where the soil material is so rocky, so shallow, so severely eroded, or so variable that it has not been classified by soil series. These places are shown on the soil map and are described in the survey, but they are called miscellaneous areas and are given descriptive names. The Rock outcrop part of Ritchey soils and Rock outcrop is a miscellaneous area.

While a soil survey is in progress, soil scientists take soil samples needed for laboratory measurements and for engineering tests. Laboratory data from the same kind of soil in other places are also assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kind of soil. Yields under defined management are estimated for all the soils.

Soil scientists observe how soils behave when used as a growing place for native and cultivated plants, and as material for structures, foundations for structures, or covering for structures. They relate this behavior to properties of the soils. For example, they observe that filter fields for onsite disposal of sewage fail on a given kind of soil, and they relate this to the slow permeability of the soil or its high water table. They see that streets, road pavements, and foundations for houses are cracked on a named kind of soil and they relate this failure to the high shrink-swell potential of the soil material. Thus, they use observation and knowledge of soil properties, together with available research data, to predict limitations or suitability of soils for present and potential uses.

After data have been collected and tested for the key, or benchmark, soils in a survey area, the soil scientists set up trial groups of soils. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others. They then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under current methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in the survey area. A soil association is a landscape that has a distinctive pattern of soils in defined proportions. It typically consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in an association can occur in other associations, but in different patterns.

A map showing soil associations is useful to people who want to have a general idea of the soils in a survey area, who want to compare different parts of that area, or who want to locate large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide for managing a watershed, a wooded tract, or a wildlife area or for broad planning of recreational facilities, community developments and such engineering works as transportation corridors. It is not a suitable map for detailed planning for management of a farm or field or for selecting the exact location of a road or building or other structure, because the soils within an association ordinarily vary in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The soil associations in St. Croix County have been grouped into two general kinds of landscapes for broad interpretative purposes. Each of the broad groups and the soil associations in it are described on the following pages. Soil associations and delineations on the general soil map do not fully agree with those of the general soil map in adjacent counties published at a different date. Differences in the maps are the result of improvement in the classification of soils, particularly in the modifications or refinements in soil series concepts. In addition, more precise and detailed maps are needed because the uses of the general soil maps have expanded in recent years. The more modern maps meet this need. Still another difference is the pattern of occurrence of the major soils or the range in slope that is permitted within associations in different surveys.

Soils With Moderate to Very Rapid Permeability

This group consists of associations of soils that are well drained to excessively drained, that have medium to coarse textured surface layers, and that have moderate to very rapid permeability in the subsoil and substratum.

1. Amery-Cromwell association

Well drained and somewhat excessively drained, gently sloping to steep, medium textured and moderately coarse textured soils on glacial drift plains

This association consists mainly of soils on pitted drift plains. It makes up about 6 percent of the county. It is about 60 percent Amery soils, 20 percent Cromwell soils, and 20 percent minor soils.

Amery soils are gently sloping to steep and are well

drained. Typically, the surface layer is dark brown loam about 9 inches thick. The subsurface layer is about 3 inches of brown loam. The subsoil is about 19 inches thick. It is brown and reddish brown, friable sandy loam. The substratum, to a depth of 60 inches, is yellowish red, friable sandy loam.

Cromwell soils are sloping to steep and are somewhat excessively drained. Typically, the surface layer is dark brown sandy loam about 8 inches thick. The subsoil is about 34 inches thick. It is yellowish red, friable, heavy sandy loam in the upper part; yellowish red, very friable, heavy loamy sand in the middle part; and yellowish red, very friable gravelly loamy sand in the lower part. The substratum, to a depth of 60 inches, is strong brown, loose sand.

Among the minor soils in this association are Antigo, Chetek, Onamia, and Santiago soils and Jewett, sandy substratum. Antigo soils are on stream terraces, and Chetek and Onamia soils are on pitted outwash plains. Jewett, sandy substratum, and Santiago soils are on till plains. Ponds, small lakes, and small areas of Saprists and Aquents are common throughout this association.

This association is suited mainly to hay, pasture, and trees, but a few areas of gently sloping and sloping soils are suited to corn, oats, soybeans, and alfalfa. Controlling erosion and soil blowing and maintaining soil fertility are the main concerns of management.

The main enterprises are feeding beef cattle and some dairying, but land use is changing to recreational uses and to homesites. Where slopes are less than 6 percent, Amery soils have slight limitations for homesites and trench type sanitary landfill; they have moderate limitations for septic tank absorption fields, local roads and streets, and sewage lagoons. Where slopes are 6 to 12 percent, Cromwell soils have moderate limitations for homesites, septic tank absorption fields, and local roads and streets. They have severe limitations for trench type sanitary landfill and sewage lagoons.

2. *Burkhardt-Chetek-Sattre association*

Well drained and somewhat excessively drained, nearly level to steep, medium textured and moderately coarse textured soils on outwash plains and stream terraces

This association consists mostly of soils on pitted outwash plains (fig. 1). It makes up about 16 percent of the county.

***Figure 1.*—Typical landscape in the Burkhardt-Chetek-Sattre association.**

It is about 30 percent Burkhardt soils, 15 percent Chetek soils, 15 percent Sattre soils, and 40 percent minor soils.

Burkhardt soils are on stream terraces, outwash plains, and the top parts of pitted outwash plains. They are nearly level to steep and are somewhat excessively drained. Typically, the surface layer is very dark brown, very dark grayish brown, and dark yellowish brown sandy loam about 12 inches thick. The subsoil is about 8 inches thick. It is brown, friable sandy loam in the upper part and brown, very friable loamy sand in the lower part. The substratum, to a depth of 60 inches, is brownish yellow sand and gravel.

Chetek soils are on pitted outwash plains. They are sloping to steep and are somewhat excessively drained. Typically, the surface layer is dark brown sandy loam about 6 inches thick. The subsoil is about 13 inches thick. It is brown, friable, heavy sandy loam in the upper part and brown, very friable loamy sand in the lower part. The substratum, to a depth of 60 inches, is strong brown sand and gravel.

Sattre soils are on stream terraces and pitted outwash plains. They are intermingled with Burkhardt soils in most places. They are gently sloping to steep and are well drained. Typically, the surface layer is very dark grayish brown silt loam about 9 inches thick. The subsurface layer is dark grayish brown silt loam about 2 inches thick. The subsoil is about 19 inches thick. It is dark yellowish brown, friable silt loam in the upper part; dark brown, friable loam in the middle part; and dark brown, very friable sandy loam in the lower part. The substratum, to a depth of 60 inches, is yellowish brown sand and gravel.

Among the minor soils in this association are Amery, Antigo, Cromwell, Dakota, Emmert, Onamia, and Santiago soils. Amery soils are generally on pitted glacial drift. Antigo, Dakota and Onamia soils are on stream terraces, outwash plains, and foot slopes of pitted outwash. Antigo and Onamia soils are closely associated with Chetek soils, whereas Dakota soils are closely associated with Burkhardt and Sattre soils. Emmert soils are on the tops of knolls and are closely intermingled with Burkhardt and Chetek soils. Cromwell soils are on knolls of pitted glacial drift and are closely intermingled with Amery soils. Santiago soils are on foot slopes and ridgetops and are closely associated with Amery soils. Ponds are common in depressions and potholes.

Most of this association is suited to hay, permanent pasture, and trees. Burkhardt and Chetek soils are subject to soil blowing. They have low natural fertility and low available water capacity. Sattre soils have medium natural fertility and moderate available water capacity. A few extensive areas of nearly level and gently sloping Burkhardt soils are suitable for irrigation and for growing such crops as beans, peas, potatoes, and strawberries. Controlling erosion and soil blowing and maintaining fertility and organic matter content are important factors of good management.

The main enterprises are feeding beef cattle and dairying, but in many areas land is being sold for scenic homesites. Where slopes are less than 6 percent, Burkhardt and Sattre soils have slight limitations for homesites, septic tank absorption fields, and local roads. These soils have severe limitations for trench type sanitary landfill and sewage lagoons. Where slopes are 6 to 12 percent, Chetek soils have moderate limitations for homesites, septic tank absorption fields, and local roads and streets. They have severe limitations for trench type sanitary landfill and sewage lagoons.

3. Sattre-Pillot-Antigo association

Well drained, nearly level to sloping, medium textured soils on outwash plains and stream terraces

This association consists of soils on stream terraces and outwash plains. It makes up about 18 percent of the county. It is about 30 percent Sattre soils, 20 percent Pillot soils, 15 percent Antigo soils, and 35 percent minor soils.

Sattre soils are on stream terraces and outwash plains. They are nearly level to sloping and are well drained. Typically, the surface layer is very dark grayish brown silt loam about 9 inches thick. The subsurface layer is dark grayish brown silt loam about 2 inches thick. The subsoil is about 19 inches thick. It is dark yellowish brown, friable silt loam in the upper part; dark brown, friable loam in the middle part; and dark brown, very friable sandy loam in the lower part. The substratum, to a depth of 60 inches, is yellowish brown sand and gravel.

Pillot soils are on stream terraces and outwash plains. They are nearly level and gently sloping and are well drained. Typically, the surface layer is very dark brown silt loam about 15 inches thick. The subsoil is about 22 inches thick. It is dark brown, friable silt loam in the upper part; dark yellowish brown, friable, heavy silt loam in the middle part; and brown, friable loam in the lower part. The substratum, to a depth of 60 inches, is yellowish brown sand and gravel.

Antigo soils are on stream terraces and outwash plains. They are nearly level to sloping and are well drained. Typically, the surface layer is dark grayish brown silt loam about 8 inches thick. The subsurface layer is brown silt loam about 10 inches thick. The subsoil is about 15 inches thick. It is dark yellowish brown, friable, heavy silt loam in the upper part; dark yellowish brown, friable loam in the middle part; and dark brown, very friable, heavy sandy loam in the lower part. The substratum, to a depth of 60 inches, is strong brown sand and gravel.

Among the minor soils in this association are Brill, Burkhardt, Chetek, Dakota, Halder, Huntsville, Lawler, and Rib soils and Fluvaquents and Fluvaquents, wet. Fluvaquents, Fluvaquents, wet, and Halder, Lawler, and Rib soils are in drainageways, on flood plains, and on low stream terraces. They are somewhat poorly drained to very poorly drained. Brill, Dakota, and Huntsville soils are in drainageways, on flood plains, and on stream terraces and outwash plains. They are moderately well drained or well drained. Burkhardt and Chetek soils are on pitted outwash and stream terraces. Burkhardt, Dakota, Huntsville, and Lawler soils are closely associated with Sattre and Pillot soils, and Brill, Chetek, Halder, and Rib soils are more closely associated with Antigo soils.

This association is well suited or moderately well suited to corn, oats, and alfalfa. Sattre and Antigo soils have medium natural fertility and moderate available water capacity. Pillot soils have high natural fertility

and moderate available water capacity. Controlling erosion and maintaining soil tilth and fertility are the main concerns of good management.

The main enterprises are dairying and feeding beef cattle. Such cash crops as corn, soybeans, peas, and beans for canning are also frequently grown. Where slopes are less than 6 percent, Sattre, Pillot, and Antigo soils have slight limitations for homesites and septic tank absorption fields. Where slopes are less than 6 percent, Sattre soils have slight limitations and Pillot and Antigo soils have moderate limitations for local roads and streets. All the major soils in this association have severe limitations for trench type sanitary landfill and sewage lagoons.

4. Plainfield-Boone association

Excessively drained, gently sloping to moderately steep, coarse textured soils on outwash plains and stream terraces, and soils underlain by sandstone at a relatively shallow depth; on uplands

This association consists of solids on outwash plains, stream terraces, and sandstone uplands. It makes up about 2 percent of the county. It is about 60 percent Plainfield soils, 15 percent Boone soils, and 25 percent minor soils.

Plainfield soils are on outwash plains and stream terraces. They are gently sloping to moderately steep and are excessively drained. Typically, the surface layer is dark brown loamy sand about 8 inches thick. The subsoil is brown, very friable sand about 16 inches thick. The substratum, to a depth of 60 inches, is strong brown sand.

Boone soils are on foot slopes, knolls, and ridges of sandstone uplands. They are gently sloping to moderately steep and are excessively drained. Typically, the surface layer is black loamy fine sand about 3 inches thick and dark brown, very friable fine sand about 2 inches thick. The subsoil is yellowish brown fine sand about 19 inches thick. The substratum, to a depth of 50 inches, is light yellowish brown fine sand and sandstone fragments. Below this, it is white, weakly cemented sandstone.

Among the minor soils in this association are Burkhardt, Chetek, Duelm, Gotham, Hesch, Hubbard, and Onamia soils. Burkhardt, Gotham, and Hubbard soils are on outwash plains and stream terraces. Chetek and Onamia soils are on knolls and foot slopes of pitted outwash. Duelm soils are on low stream terraces. Hesch soils are on knolls and valley foot slopes of sandstone uplands.

This association is suited mainly to permanent pasture or pine tree plantations but some areas are cultivated and used for growing limited amounts of corn, oats, and hay. Plainfield and Boone soils are subject to soil blowing. They have low natural fertility and low available water capacity. A few extensive areas of gently sloping Plainfield soils are suitable for irrigation and for growing such crops as beans, peas, potatoes, and strawberries. Controlling soil blowing and maintaining organic matter content are the main concerns of management.

The main enterprises are feeding beef cattle and some dairying, but land use is changing to pine tree plantations or recreational and urban uses. Where slopes are less than 6 percent, Plainfield and Boone soils have slight or moderate limitations for septic tank absorption fields and local roads and streets. Where slopes are less than 6 percent, Plainfield soils have slight limitations for homesites and Boone soils have moderate limitations for homesites. Both soils have severe limitations for trench type sanitary landfill and sewage lagoons.

Soils With Moderate to Slow Permeability

This group consists of associations of soils that are well drained to somewhat poorly drained, that have medium textured surface layers, and that have moderate to slow permeability in the subsoil and substratum.

5. Santiago-Otterholt-Arland association

Well drained, gently sloping to steep, medium textured soils on till plains, and soils underlain by sandstone at a relatively shallow depth or that have a thick mantle of windblown silt loam

This association consists of soils on sandstone and limestone uplands that are covered in most places by a thin mantle of glacial drift or a thick mantle of windblown silt loam. It makes up about 8 percent of the county. It is about 25 percent Santiago soils, 20 percent Otterholt soils, 20 percent Arland soils, and 35 percent minor soils.

Santiago soils are on ridges of till plains. They are gently sloping to steep and are well drained. Typically, the surface layer is dark grayish brown silt loam about 7 inches thick. The subsurface layer is brown silt loam about 10 inches thick. The subsoil is about 17 inches thick. It is dark brown, very friable silt loam in the upper part; reddish brown, friable loam in the middle part; and yellowish red, friable, heavy sandy loam in the lower part. The substratum, to a depth of 60 inches, is yellowish red, friable sandy loam.

Otterholt soils are on ridges and valleys of till plains and uplands where the mantle of windblown silt loam is thick. They are gently sloping to moderately steep and are well drained. Typically, the surface layer is dark grayish brown silt loam about 8 inches thick. The subsurface layer is grayish brown silt loam about 8 inches thick. The subsoil is about 29 inches thick. It is dark brown, friable silt loam in the upper part and dark yellowish brown, friable and very friable silt loam in the lower part. The substratum, to a depth of 60 inches, is yellowish brown, very friable silt loam.

Arland soils are on ridges, foot slopes, and valleys of uplands that are covered by a thin mantle of glacial drift and are underlain by sandstone at a relatively shallow depth. They are gently sloping to very steep and are well drained. Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsurface layer is brown silt loam about 3 inches thick. The subsoil is about 24 inches thick. It is brown, friable silt loam in the upper part; brown, friable loam in the middle part; and strong brown, friable, heavy sandy loam in the lower part. The substratum, to a depth of 60 inches, is very pale brown, weakly cemented sandstone.

Among the minor soils in this association are

Amery, Boone, Hesch, Magnor, Nickin, Orion, Port Byron, Ritchey, Vlasaty, and Whalan soils. Fluvaquents are also minor soils in this association. Amery soils are on till plains and end moraines. Boone soils are on sandstone uplands. Magnor soils are in drainageways of till plains. Hesch and Nickin soils are on ridges, valleys, and foot slopes of sandstone uplands. Orion soils and Fluvaquents are in the drainageways and on the flood plains of rivers and streams. Port Byron soils are along drainageways, draws and footslopes of uplands. Ritchie soils are on limestone escarpments. Vlasaty soils are on till plains that consist of heavy loam or clay loam till. Whalan soils are on limestone uplands covered by a thin mantle of glacial till. In addition to the minor soils in this association, there are also areas of somewhat poorly drained, deep silty soils. On the general soil map of the published soil survey for Dunn County, these soils are shown extending into St. Croix County, but their total area is so small in St. Croix County that they are not shown as a separate soil association.

Most of the gently sloping and sloping soils in this association are cultivated. They are well suited or suited to corn, oats, and alfalfa. Most of the steeper soils are used for alfalfa, permanent pasture, or trees. Otterholt soils have high natural fertility and very high available water capacity. Santiago soils have medium natural fertility and high available water capacity. Arland silt loam has medium natural fertility, and Arland sandy loam has low natural fertility. Arland soils have moderate available water capacity. Controlling erosion and maintaining soil tilth and fertility are important factors of good management.

Where slopes are less than 6 percent, the major soils in this association have mostly slight or moderate limitations for homesites, septic tank absorption fields, local roads and streets, trench type sanitary landfill, and sewage lagoons. Otterholt soils have severe limitations for local roads and streets and Arland soils have severe limitations for trench type sanitary landfill and sewage lagoons.

6. *Ritchey-Derinda-Whalan association*

Well drained and moderately well drained, gently sloping to very steep, medium textured soils underlain by limestone or shale at a relatively shallow depth; on uplands

This association consists of soils on limestone and shale uplands. It makes up about 2 percent of the county. It is about 30 percent Ritchey soils, 16 percent Derinda soils, 15 percent Whalan soils, and 39 percent minor soils.

Ritchey soils are on ridges and knolls of uplands in areas where limestone is at a relatively shallow depth. They are gently sloping to very steep and are well drained. Typically, the surface layer is very dark brown silt loam about 3 inches thick. The subsurface layer is yellowish brown silt loam about 3 inches thick. The subsoil is about 12 inches thick. It is reddish brown, friable silt loam in the upper part and reddish brown, friable, heavy loam in the lower part. Dolomitic limestone is at a depth of about 18 inches.

Derinda soils are on ridge tops of shale uplands. They are gently sloping and sloping and are moderately well drained. Typically, the surface layer is very dark grayish brown silt loam about 9 inches thick. The subsurface layer is dark grayish brown silt loam about 2 inches thick. The subsoil is about 19 inches thick. It is yellowish brown, mottled, friable silt loam in the upper part; dark brown, mottled, firm silty clay loam in the middle part; and olive gray, mottled, firm silty clay in the lower part. The substratum, to a depth of 60 inches, is olive clay shale interbedded with fragmented dolomitic limestone.

Whalan soils are on ridges and knolls and in valleys in areas where limestone is at a relatively shallow depth. They are gently sloping to steep and are well drained. Typically, the surface layer is dark grayish brown silt loam about 8 inches thick. The subsoil is about 26 inches thick. It is dark brown, friable silt loam in the upper part; yellowish red, firm loam in the middle part; and reddish brown, firm clay loam in the lower part. Dolomitic limestone is at a depth of about 34 inches.

Among the minor soils in this association are Magnor, Santiago, and Vlasaty soils and Derinda Variant and Freeon, heavy substratum. Freeon, heavy substratum, soils and Vlasaty soils are on low ridges of till plains. Magnor soils are in drainageways of till plains. Derinda Variant soils are in drainageways of shale uplands. Santiago soils are on ridges of till plains. In addition to the minor soils in this association, there are areas of somewhat poorly drained soils with a thick, dark surface layer that is underlain by silty clay weathered from shale. On the general soil map of the published soil survey for Pierce County, these areas are shown extending into St. Croix County, but their total area is so small in St. Croix County that they are not shown as a separate soil association.

Many soils in this association have a shallow root zone and are moderately steep or steep. These soils are suited to hay, permanent pasture, or trees. Some gently sloping and sloping soils are suited to corn, oats, and alfalfa. Ritchey, Derinda, and Whalan soils have medium natural fertility. Ritchey soils have low available water capacity, and Derinda and Whalan soils have moderate available water capacity. Ritchey soils have moderate permeability, Derinda soils have slow permeability, and Whalan soils have moderately slow permeability. Controlling erosion, maintaining soil tilth, and removing ponded water in some areas are important factors of good management.

Some areas in this association are used for growing corn, oats, and hay, but many areas are in permanent pasture and trees. Dairying and feeding beef cattle are the main enterprises. The major soils in this association have mostly severe limitations for homesites, septic tank absorption fields, local roads and streets, trench type sanitary landfill, and sewage lagoons. Where slopes are less than 6 percent, Derinda soils have moderate limitations for sewage lagoons and Whalan soils have moderate limitations for local roads and streets.

7. *Santiago-Jewett-Magnor association*

Well drained and somewhat poorly drained, nearly level to sloping, medium textured soils on till plains

This association consists of soils on till plains. It makes up about 34 percent of the county. It is about

24 percent Santiago soils, 19 percent Jewett soils, 11 percent Magnor soils, and 46 percent minor soils.

Santiago soils are mostly in the eastern part of this association on ridges of till plains. They are gently sloping and sloping and are well drained. Typically, the surface layer is dark grayish brown silt loam about 7 inches thick. The subsurface layer is brown silt loam about 10 inches thick. The subsoil is about 17 inches thick. It is dark brown, very friable silt loam in the upper part; reddish brown, friable loam in the middle part; and yellowish red, friable heavy sandy loam in the lower part. The substratum, to a depth of 60 inches, is yellowish red, friable sandy loam.

Jewett soils are mostly in the western part of this association on ridges and wide drainageways of till plains. They are nearly level to sloping and are well drained. Typically, the surface layer is very dark grayish brown silt loam about 9 inches thick. The subsurface layer is dark grayish brown silt loam about 2 inches thick. The subsoil is about 26 inches thick. It is brown, friable silt loam in the upper part; brown, friable, heavy loam in the middle part; and yellowish red, friable sandy loam in the lower part. The substratum, to a depth of 60 inches, is yellowish red, friable sandy loam.

Magnor soils are in the drainageways of till plains. They are nearly level and gently sloping and are somewhat poorly drained. Typically, the surface layer is very dark brown silt loam about 4 inches thick. The subsurface layer is pale brown silt loam about 14 inches thick. The subsoil is about 14 inches thick. It is mottled, brown, firm loam in the upper part and reddish brown, friable, heavy sandy loam in the lower part. The substratum, to a depth of 60 inches, is yellowish red, friable sandy loam.

Among the minor soils are Adolph, Amery, Antigo, Arland, Freeon, Halder, and Vlasaty soils, and Freeon, heavy substratum, and Jewett, sandy substratum. Adolph soils are in depressional areas on ground moraines and pitted glacial drift. Antigo and Halder soils are on stream terraces. Arland soils are on sandstone uplands that are covered by a thin mantle of glacial drift. Freeon and Freeon, heavy substratum, soils are on low ridges of ground moraines and are closely associated with Santiago soils. Jewett, sandy substratum, soils are on benches and in drainageways of ground moraines and are closely associated with other Jewett soils. Vlasaty soils are on low ridges of ground moraines consisting of heavy loam or clay loam till. On the general soil map of the published soil survey for Dunn County, an area of deep, well drained and somewhat poorly drained, silty soils is shown extending into St. Croix County, but the total area of these soils is so small in St. Croix County that it is not shown as a separate association.

Most of this association is cultivated. The well drained and moderately well drained soils are suited to growing corn, oats, alfalfa, and some special cash crops such as corn, peas, and beans for canning. The somewhat poorly drained soils are suited to wetland pasture and wildlife habitat, but are also used for growing limited amounts of corn, oats, and hay. Jewett soils have high natural fertility; Santiago and Magnor soils have medium natural fertility. These soils have high available water capacity. Magnor soils are somewhat poorly drained; but, where adequately drained, they are suited to corn and most other crops. Controlling erosion, maintaining soil tilth and fertility, and draining the somewhat poorly drained to very poorly drained soils are the main concerns of management.

Most soils in this association are used for growing corn, oats, and alfalfa. Such special cash crops as corn, peas, and beans for canning are also commonly grown on Jewett soils. Dairying is the main enterprise.

Jewett soils and gently sloping and sloping Santiago soils have slight or moderate limitations for homesites, septic tank absorption fields, local roads and streets, trench type sanitary landfill, and sewage lagoons. Magnor soils have severe limitations for most of these uses.

8. Vlasaty-Skyberg association

Moderately well drained and somewhat poorly drained, nearly level to sloping, medium textured soils on till plains

This association consists of soils on till plains. It makes up about 14 percent of the county. It is about 30 percent Vlasaty soils, 24 percent Skyberg soils, and 46 percent minor soils.

Vlasaty soils are on low ridges of till plains. They are gently sloping and sloping, and are moderately well drained. Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsurface layer is pale brown silt loam about 3 inches thick. The subsoil is about 31 inches thick. It is dark yellowish brown, friable, heavy silt loam in the upper part and brown and dark grayish brown, mottled, very firm clay loam in the lower part. The substratum, to a depth of 60 inches, is olive brown, mottled, very firm clay loam.

Skyberg soils are in drainageways and on foot slopes of till plains. They are nearly level and gently sloping and are somewhat poorly drained. Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsurface layer is mottled, grayish brown silt loam about 10 inches thick. The subsoil is grayish brown, mottled, firm, heavy loam about 14 inches thick. The substratum, to a depth of 60 inches, is grayish brown, mottled, firm, heavy loam.

Among the minor soils in this association are Antigo, Arland, Auburndale, Clyde, Floyd, Halder, Renova, and Whalan soils. Antigo and Halder soils are on stream terraces and outwash plains. Arland soils are on sandstone uplands that are covered by a thin mantle of glacial drift. Auburndale, Clyde, and Floyd soils are in depressions and drainageways on till plains. Renova soils are on ridges and knolls of till plains. Whalan soils are on limestone uplands that are covered by a thin mantle of glacial till. The general soil map of the published soil survey for Pierce County shows a Renova-Vlasaty association extending into St. Croix County, but the areas of Renova soils in St. Croix County are too small and minor to be shown on the general soil map for St. Croix County.

Most of this association is cultivated. Vlasaty and Skyberg soils have high natural fertility and high available water capacity. Vlasaty soils are suited to corn, oats, and hay. Where adequately drained, Skyberg soils are also suited to crops commonly grown in the county.

Most of this association is used to grow corn, oats, and hay, but many areas of the somewhat poorly drained to very poorly drained soils are in permanent pasture or woods. Dairying is the main enterprise. Vlasaty and Skyberg soils have mostly severe limitations for homesites, septic tank absorption fields, local roads and streets, and trench type sanitary landfill. Vlasaty soils have moderate limitations for homesites and, where slopes are less than 6 percent, they have moderate limitations for sewage lagoons. Skyberg soils have slight limitations for sewage lagoons.

Descriptions of the Soils

This section describes the soil series and mapping units in St. Croix County. Each soil series is described in detail, and then, briefly, each mapping unit in that series. Unless it is specifically mentioned otherwise, it is to be assumed that what is stated about the soil series holds true for the mapping units in that series. Thus, to get full information about any one mapping unit, it is necessary to read both the description of the mapping unit and the description of the soil series to which it belongs.

An important part of the description of each soil series is the soil profile, that is, the sequence of layers from the surface downward to rock or other underlying material. Each series contains two descriptions of this profile. The first is brief and in terms familiar to the layman. The second is much more detailed and is for those who need to make thorough and precise studies of soils. Color terms are for moist soil unless otherwise stated. The profile described in the series is representative for mapping units in that series. If the profile of a given mapping unit is different from the one described for the series, these differences are stated in describing the mapping unit, or they are differences that are apparent in the name of the mapping unit.

As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. Cut and fill areas, for example, do not belong to a soil series, but nevertheless, these areas are listed in alphabetic order along with the soil series.

Preceding the name of each mapping unit is a symbol. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit are the capability unit and woodland group in which the mapping unit has been placed. The page for the description of each capability unit, woodland group, or other interpretative group can be found by referring to the "Guide to Mapping Units" at the back of this survey.

The acreage and proportionate extent of each mapping unit are shown in table 1. Many of the terms used in describing soils can be found in the Glossary at the end of this survey, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (*27*).[2]

Adolph Series

The Adolph series consists of nearly level and gently sloping, very poorly drained soils in drainageways and depressions of ground moraines. These soils formed in silt sediment and the underlying sandy loam glacial till. Native vegetation was mostly wetland grasses and sedges with some shrubs such as alder and willow and a few scattered trees such as elm, black ash, and tamarack. Unless these soils are drained, water is at or near the surface throughout the year.

In representative profile the surface layer is about 14 inches thick. It is black silt loam in the upper 10 inches and very dark gray, mottled silt loam in the lower 4 inches. The subsoil is about 24 inches thick. It is dark grayish brown and grayish brown, mottled, friable silt loam in the upper part and grayish brown, reddish brown, and yellowish red, mottled, friable, heavy sandy loam in the lower part. The substratum, to a depth of about 60 inches, is yellowish red, mottled, friable heavy sandy loam.

Available water capacity is high. Permeability is moderately slow. Natural fertility is medium. The organic matter content of the surface layer is high. Depth of the root zone is limited for major farm crops by a perched water table at or near the soil surface.

Most areas of these soils are in wetland pasture or wildlife habitat. Where drained, they are suited to corn and other row crops.

Representative profile of Adolph silt loam, 0 to 3 percent slopes, in an uncultivated pasture, about 100 yards south and 80 yards west of northeast corner of sec. 31, T. 30 N., R. 16 W.:

A1—0 to 10 inches; black (10YR 2/1) silt loam; moderate, medium subangular blocky and granular structure; friable; common roots; medium acid; clear smooth boundary.

A12—10 to 14 inches; very dark gray (10YR 3/1) silt loam; common medium faint dark grayish brown (10YR 4/2) mottles; weak, medium and fine granular structure; friable; common roots; medium acid; clear smooth boundary.

B1g—14 to 17 inches; dark grayish brown (10YR 4/2) silt loam; few fine prominent strong brown (7.5YR 5/6) mottles; moderate fine subangular blocky structure; friable; common roots; slightly acid; clear wavy boundary.

B2g—17 to 23 inches; grayish brown (2.5Y 5/2) silt loam; common fine prominent yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; friable; few roots; slightly acid; clear wavy boundary.

IIB3g—23 to 31 inches; grayish brown (10YR 5/2) heavy sandy loam; common medium prominent yellowish brown (10YR 5/6) and faint dark grayish brown (10YR 4/2) mottles; moderate coarse subangular blocky structure; friable; about 15 percent coarse fragments by volume; slightly acid; clear wavy boundary.

IIB3—31 to 38 inches; reddish brown (5YR 4/4) and yellowish red (5YR 5/6) heavy sandy loam; common fine prominent dark grayish brown (10YR 4/2) and light brownish gray (10YR 6/2) mottles; weak coarse subangular blocky structure;

[2] Italic numbers in parentheses refer to References, p. 141.

TABLE 1.—*Approximate acreage and proportionate extent of the soils*

Soil	Acres	Percent
Adolph silt loam, 0 to 3 percent slopes	1,750	0.4
Amery sandy loam, 2 to 6 percent slopes	1,000	.2
Amery sandy loam, 6 to 12 percent slopes, eroded	2,300	.5
Amery sandy loam, 12 to 25 percent slopes, eroded	3,000	.6
Amery loam, 2 to 6 percent slopes	4,550	1.0
Amery loam, 6 to 12 percent slopes, eroded	14,900	3.2
Amery loam, 12 to 20 percent slopes, eroded	9,700	2.1
Amery loam, 20 to 30 percent slopes, eroded	1,650	.4
Amery-Cromwell sandy loams, 6 to 12 percent slopes, eroded	4,900	1.0
Amery-Cromwell sandy loams, 12 to 25 percent slopes, eroded	4,700	1.0
Antigo silt loam, 0 to 2 percent slopes	2,200	.5
Antigo silt loam, 2 to 6 percent slopes	11,400	2.4
Arland sandy loam, 6 to 12 percent slopes, eroded	2,520	.5
Arland sandy loam, 12 to 25 percent slopes, eroded	3,450	.7
Arland sandy loam, 25 to 35 percent slopes	1,400	.3
Arland silt loam, 2 to 6 percent slopes	4,500	1.0
Arland silt loam, 6 to 12 percent slopes, eroded	3,800	.8
Auburndale silt loam, 0 to 3 percent slopes	2,380	.5
Boone loamy fine sand, 2 to 6 percent slopes	450	.1
Boone loamy fine sand, 6 to 12 percent slopes	720	.2
Boone loamy fine sand, 12 to 20 percent slopes	1,050	.2
Brill silt loam, 0 to 3 percent slopes	1,900	.4
Burkhardt sandy loam, 1 to 6 percent slopes	2,600	.6
Burkhardt sandy loam, 6 to 12 percent slopes, eroded	1,800	.4
Burkhardt-Sattre complex, 2 to 6 percent slopes	4,920	1.0
Burkhardt-Sattre complex, 6 to 12 percent slopes, eroded	11,300	2.4
Burkhardt-Sattre complex, 12 to 30 percent slopes, eroded	9,760	2.1
Chetek-Onamia complex, 6 to 12 percent slopes, eroded	6,630	1.4
Chetek-Onamia complex, 12 to 20 percent slopes, eroded	5,950	1.3
Chetek-Onamia complex, 20 to 30 percent slopes	1,200	.3
Clyde silt loam, 0 to 3 percent slopes	2,300	.5
Cut and fill areas	200	(1)
Dakota loam, 0 to 2 percent slopes	720	.2
Dakota loam, 2 to 6 percent slopes	1,950	.4
Dakota-Pillot complex, 6 to 12 percent slopes, eroded	950	.2
Derinda silt loam, 2 to 6 percent slopes	1,100	.2
Derinda silt loam, 6 to 12 percent slopes, eroded	500	.1
Derinda Variant, silt loam, 1 to 6 percent slopes	870	.2
Dickman sandy loam, 2 to 6 percent slopes	940	.2
Duelm loamy sand	320	.1
Emmert loamy sand, 12 to 35 percent slopes	5,640	1.2
Floyd silt loam, 0 to 3 percent slopes	2,600	.6
Fluvaquents	5,900	1.3
Fluvaquents, wet	3,800	.8
Freeon silt loam, 2 to 6 percent slopes	21,200	4.5
Freeon silt loam, heavy substratum, 2 to 6 percent slopes	4,300	.9
Freeon silt loam, heavy substratum, 6 to 12 percent slopes, eroded	1,650	0.4
Gotham loamy fine sand, 2 to 6 percent slopes	680	.1
Gotham loamy fine sand, 6 to 12 percent slopes	380	.1
Gravel pits	1,070	.2
Halder silt loam, 0 to 3 percent slopes	3,980	.8
Hesch fine sandy loam, 2 to 6 percent slopes	370	.1
Hesch fine sandy loam, 6 to 12 percent slopes, eroded	530	.1
Hesch fine sandy loam, 12 to 20 percent slopes, eroded	550	.1
Hubbard loamy sand, 0 to 6 percent slopes	1,420	.3
Hubbard loamy sand, loamy substratum, 0 to 6 percent slopes	890	.2
Hubbard loamy sand, loamy substratum, 6 to 12 percent slopes	670	.1
Huntsville silt loam, 0 to 3 percent slopes	4,460	.9
Jewett silt loam, 0 to 2 percent slopes	1,850	.4
Jewett silt loam, 2 to 6 percent slopes	15,100	3.2
Jewett silt loam, 6 to 12 percent slopes, eroded	900	.2
Jewett silt loam, sandy substratum, 0 to 2 percent slopes	2,100	.4
Jewett silt loam, sandy substratum, 2 to 6 percent slopes	10,100	2.1
Lawler silt loam, 0 to 3 percent slopes	920	.2
Magnor silt loam, 1 to 6 percent slopes	19,300	4.1
Nickin silt loam, 2 to 6 percent slopes	5,450	1.1
Nickin silt loam, 6 to 12 percent slopes, eroded	2,650	.6
Nickin loam, 12 to 20 percent slopes, eroded	600	.1
Onamia loam, 2 to 6 percent slopes	3,400	.7
Onamia loam, 6 to 12 percent slopes, eroded	1,800	.4
Onamia-Antigo complex, 6 to 12 percent slopes, eroded	4,750	1.0
Onamia-Antigo complex, 12 to 25 percent slopes, eroded	1,800	.4
Orion silt loam, 0 to 3 percent slopes	2,100	.4
Otterholt silt loam, 2 to 6 percent slopes	3,100	.7
Otterholt silt loam, 6 to 12 percent slopes	4,600	1.0
Otterholt silt loam, 12 to 20 percent slopes, eroded	1,850	.4
Pillot silt loam, 0 to 3 percent slopes	14,900	3.2
Plainfield loamy sand, 2 to 6 percent slopes	1,950	.4
Plainfield loamy sand, 6 to 12 percent slopes	3,300	.7
Plainfield loamy sand, 12 to 20 percent slopes	2,300	.5
Port Byron silt loam, 2 to 6 percent slopes	800	.2
Port Byron silt loam, 6 to 12 percent slopes	640	.1
Port Byron silt loam, 12 to 20 percent slopes	560	.1
Renova silt loam, 2 to 6 percent slopes	690	.1
Renova silt loam, 6 to 12 percent slopes, eroded	1,150	.2
Renova Variant loam, 4 to 12 percent slopes, eroded	1,350	.3
Renova Variant loam, 12 to 20 percent slopes, eroded	860	.2
Rib silt loam, 0 to 3 percent slopes	2,200	.5
Ritchey silt loam, 2 to 6 percent slopes	380	.1
Ritchey silt loam, 6 to 12 percent slopes, eroded	600	.1

TABLE 1.—*Approximate acreage and proportionate extent of the soils*—Continued

Soil	Acres	Percent	Soil	Acres	Percent
Ritchey silt loam, 12 to 20 percent slopes, eroded	1,450	.3	Sattre loam, 2 to 6 percent slopes	7,350	1.6
Ritchey soils and Rock outcrop, 20 to 35 percent slopes	6,650	1.4	Sattre loam, 6 to 12 percent slopes, eroded	3,150	.7
Rockton silt loam, 2 to 6 percent slopes	990	.2	Sattre silt loam, 0 to 2 percent slopes	7,000	1.5
Rockton silt loam, 6 to 12 percent slopes, eroded	500	.1	Sattre silt loam, 2 to 6 percent slopes	16,800	3.6
Rockton silt loam, 12 to 20 percent slopes, eroded	560	.1	Seelyeville muck	2,600	.6
Santiago silt loam, 2 to 6 percent slopes	34,800	7.5	Skyberg silt loam, 0 to 3 percent slopes	16,200	3.4
Santiago silt loam, 6 to 12 percent slopes, eroded	13,300	2.8	Udifluvents	1,100	.2
Santiago-Antigo complex, 6 to 12 percent slopes, eroded	4,850	1.0	Vlasaty silt loam, 2 to 6 percent slopes	18,500	4.0
Santiago-Antigo complex, 12 to 25 percent slopes, eroded	1,250	.3	Vlasaty silt loam, 6 to 12 percent slopes, eroded	3,250	.7
Saprists and Aquents	1,960	.4	Whalan silt loam, 2 to 6 percent slopes	2,950	.6
Sattre loam, 0 to 2 percent slopes	2,050	.4	Whalan silt loam, 6 to 12 percent slopes, eroded	3,100	.7
			Whalan silt loam, 12 to 25 percent slopes, eroded	1,300	.3
			Water	5,730	1.2
			Total	469,760	100.0

[1] Less than 0.05 percent.

friable; about 10 percent coarse fragments by volume; slightly acid; clear wavy boundary.

IIC—38 to 60 inches; yellowish red (5YR 4/8) heavy sandy loam; many large faint strong brown (7.5YR 5/8) and prominent grayish brown (10YR 5/2) mottles; massive; friable; common pebbles; 10 percent cobblestones and boulders by volume; neutral.

The solum ranges from 30 to 50 inches in thickness. Depth to sandy loam till ranges from 18 to 34 inches. The A horizon is black, very dark brown, or very dark gray and 10 to 20 inches thick.

The C horizon is sandy loam or gravelly sandy loam. The lower part of the B horizon and the C horizon are 5 to 15 percent coarse fragments.

These Adolph soils have slightly more clay in the B horizon and upper part of the C horizon than the defined range of the series, but this difference does not alter their usefulness or behavior.

Adolph soils are near Freeon, Magnor, and Santiago soils. All these soils have a silt loam mantle underlain by sandy loam till. Adolph soils are more poorly drained than Freeon, Magnor, and Santiago soils.

AdA—Adolph silt loam, 0 to 3 percent slopes. This soil is in drainageways and depressions. Most areas are elongated and range from 4 to 40 acres in size.

Included with this soil in mapping are a few small areas of Fluvaquents, wet, and Saprists and Aquents. Also included are some small areas of soils where layers of heavy loam till or sandy outwash are in the substratum.

This soil has a perched water table at or near the soil surface throughout most the year. Runoff is very slow. This soil is ponded or flooded during wet seasons. Shallow surface ditches, water diversions, and tile drains help drain areas where a good natural outlet exists. Frosts are common on this soil late in spring and early in fall.

This soil is suited to wetland pasture and wildlife habitat. If adequately drained, a few areas are suited to row crops. Capability unit IVw–3; woodland group 5w1.

Amery Series

The Amery series consists of gently sloping to steep, well drained soils on ground moraines, end moraines, and areas of pitted drift. These are loamy soils underlain by sandy loam till. Native vegetation was mainly white pine, red oak, white birch, and aspen.

In a representative profile the surface layer is dark brown loam about 9 inches thick. The subsurface layer is about 3 inches of brown loam. The subsoil is brown and reddish brown, friable sandy loam about 19 inches thick. The substratum, to a depth of 60 inches, is yellowish red, friable sandy loam.

Available water capacity and permeability are moderate. Natural fertility ranges from medium to low. The organic matter content of the surface layer is moderate.

Most areas of these soils are moderately steep or steep. The steeper soils are in hayland, pasture, or woodland. The gently sloping and sloping soils are used for corn, oats, and alfalfa.

Representative profile of Amery loam, 6 to 12 percent slopes, eroded, in a cultivated area, 30 yards east and 770 yards north of southwest corner of sec. 21, T. 30 N., R. 15 W.:

Ap—0 to 9 inches; dark brown (10YR 3/3) loam, high sand content; moderate medium subangular blocky structure parting to moderate fine and medium granular; friable; many roots; neutral; abrupt smooth boundary.

A2—9 to 12 inches; brown (10YR 5/3) loam, high sand content; weak medium platy structure; friable; common roots; neutral; clear wavy boundary.

A&B—12 to 15 inches; brown (10YR 5/3) heavy sandy loam (A2); weak medium platy

structure; brown (7.5YR 4/4) heavy sandy loam (B2t); moderate medium and fine subangular blocky structure; friable; common roots; about 15 percent coarse fragments by volume; neutral; clear wavy boundary.

IIB22t—15 to 24 inches; reddish brown (5YR 4/4) heavy sandy loam; moderate medium subangular blocky structure; friable; few roots; about 15 percent coarse fragments by volume; medium acid; clear wavy boundary.

IIB3—24 to 31 inches; reddish brown (5YR 4/4) sandy loam; weak coarse subangular blocky structure; friable; few roots; about 15 percent coarse fragments by volume; few strong brown (7.5YR 5/8) sand coatings on faces of peds; slightly acid; clear wavy boundary.

IIC—31 to 60 inches; yellowish red (5YR 4/6) sandy loam; massive; about 15 percent coarse fragments by volume; friable; few roots; slightly acid.

The solum ranges from 30 to 40 inches in thickness. The Ap horizon is dark grayish brown or dark brown sandy loam or loam 5 to 10 inches thick. In uncultivated areas the A horizon is very dark brown or very dark grayish brown and 2 to 4 inches thick.

The B horizon is sandy loam or sandy clay loam. The C horizon is mainly sandy loam, but it ranges to loamy sand in places. The B and C horizons are 5 to 15 percent coarse fragments. These soils are medium acid to neutral in the B horizon and medium acid or slightly acid in the C horizon.

Amery soils are near Cromwell and Santiago soils and Jewett, sandy substratum. They lack the moderately thick silt mantle and the loam B horizon typical of Santiago soils and Jewett, sandy substratum, soils. Also, Amery soils lack the sandy C horizon typical of Cromwell soils and Jewett, sandy substratum, soils. They contain more clay and less sand than Cromwell soils.

A1B—Amery sandy loam, 2 to 6 percent slopes. This soil is on ridges of ground moraines or on knolls and foot slopes of pitted glacial drift. Most areas are irregular in shape and range from 5 to 40 acres in size.

This soil has a profile similar to the one described as representative of the series, but the subsoil is thicker and the surface layer is sandy loam rather than loam.

Included with this soil in mapping are a few areas of deep, silty soils and a few areas of Amery loams and silt loams. Also included are a few small areas where slopes are less than 2 percent or more than 6 percent.

Runoff is slow, and the hazard of erosion is slight. This soil is subject to soil blowing.

Most areas of this soil are cultivated. The soil is moderately well suited to corn, oats, alfalfa, and most crops commonly grown in the county. Controlling erosion and soil blowing are important factors of good management. Capability unit IIIe–4; woodland group 2o1.

A1C2—Amery sandy loam, 6 to 12 percent slopes, eroded. This soil is on end moraines and pitted glacial drift. Most areas are irregular in shape and range from 5 to 60 acres in size.

This soil has a profile similar to the one described as representative of the series, but its subsoil is thicker and the surface layer contains more sand.

Included with this soil in mapping are a few small areas of Amery loams and silt loams and Cromwell soils. Also included are a few areas where layers of silty sediment are in the till, a few small areas where the soil is severely eroded and has a cobbly and gravelly surface layer, and a few areas where slopes are less than 6 percent or more than 12 percent.

Runoff is medium, and the hazard of erosion is moderate. Erosion has caused deterioration of the tilth and has reduced the content of organic matter of the surface layer in most places. This soil is subject to blowing.

This soil is suited to oats, alfalfa, and a limited amount of corn. Controlling erosion and soil blowing and maintaining tilth and organic matter content are important factors of good management. Capability unit IIIe–7; woodland group 2o1.

A1D2—Amery sandy loam, 12 to 25 percent slopes, eroded. This soil is on pitted drift and end moraines. Most areas are irregular in shape and range from 5 to 100 acres in size.

This soil has a profile similar to the one described as representative of the series, but its surface layer is sandy loam rather than loam.

Included with this soil in mapping are a few areas of Amery loams and silt loams and a few areas of Cromwell and Emmert soils. Also included are a few areas where layers of silty sediment are in the till, a few small areas where the soil is severely eroded and has a cobbly and gravelly surface layer, and a few small areas where slopes are less than 12 percent or more than 25 percent.

Runoff is rapid, and the hazard of erosion is severe. In most areas erosion has caused the tilth to deteriorate and has reduced the content of organic matter in the surface layer. This soil is subject to blowing.

This soil is suited to hay, pasture, and woodland. It is frequently used for pasture. Controlling erosion and maintaining tilth and organic matter content are important factors of good management. Capability unit VIe–4; woodland group 2r1.

AmB—Amery loam, 2 to 6 percent slopes. This soil is on ridges of ground moraines. Most areas are oblong or irregular in shape and range from 10 to 40 acres in size.

In most areas this soil contains more silt than the one described as representative of the series, but otherwise the two profiles are similar.

Included with this soil in mapping are a few small areas where the surface layer is sandy loam. Also included are a few small areas where the soil is underlain by sand and gravel and a few small areas where slopes are slightly more than 6 percent.

Runoff is slow, and the hazard of erosion is slight.

This soil is well suited to corn, oats, and alfalfa. It is frequently used for corn. Controlling erosion, especially on relatively long slopes, is an important factor of good management. Capability unit IIe–1; woodland group 2o1.

AmC2—Amery loam, 6 to 12 percent slopes, eroded. This soil is on end moraines and ridges of ground moraines. Most areas are oblong to round and range from 5 to 60 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas where the surface layer is sandy loam. Also included are a few small areas of Cromwell and Santiago soils and a few small areas where slopes are slightly less than 6 percent or more than 12 percent.

Runoff is medium, and the hazard of erosion is moderate. In many areas erosion has caused deterioration of tilth and soil structure in the surface layer.

This soil is suited to oats, alfalfa, and a limited amount of corn. Controlling erosion and maintaining tilth are important factors of good management. Capability unit IIIe–1; woodland group 2o1.

AmD2—Amery loam, 12 to 20 percent slopes, eroded. This soil is on narrow ridges of ground or end moraines and on areas of pitted glacial drift. Most areas are irregular in shape and range from 5 to 100 acres in size.

This soil has a profile similar to the one described as representative of the series, but in most areas the surface layer and subsoil are thinner.

Included with this soil in mapping are some areas where the surface layer is sandy loam and a few areas of Arland, Cromwell, and Santiago soils. Also included are a few areas where the soil is severely eroded and has a cobbly, gravelly, or sandy surface layer. In a few small areas slopes are less than 12 percent or more than 20 percent.

Runoff is rapid, and the hazard of erosion is severe. Erosion has caused deterioration of tilth and soil structure in the surface layer.

This soil is suited to alfalfa and grasses for hay or pasture. It is poorly suited to row crops. Controlling erosion and maintaining tilth are necessary to good management. Capability unit IVe–2; woodland group 2r1.

AmE2—Amery loam, 20 to 30 percent slopes, eroded. This soil is on end moraines and pitted glacial drift. Most areas are irregular in shape and range from 10 to 40 acres in size.

This soil has a profile similar to the one described as representative of the series, except the surface layer and subsoil are thinner.

Included with this soil in mapping are a few small areas of Arland, Cromwell, and Whalan soils. Also included are a few small areas where slopes are less than 20 percent or more than 30 percent.

Runoff is very rapid, and the hazard of erosion is severe. In many areas erosion has caused deterioration of tilth and soil structure in the surface layer.

This soil is suited to grasses for pasture. It is generally unsuited to row crops. It is well suited to white pine, red oak, and hard maple. Slopes facing south and southwest are less suited to trees than slopes facing north and northeast. Controlling erosion is an important factor of good management. Capability unit VIe–1; woodland group 2r1.

AnC2—Amery-Cromwell sandy loams, 6 to 12 percent slopes, eroded. The soils in this complex are on end moraines and areas of pitted glacial drift. Most areas are irregular in shape and range from 10 to 120 acres in size. These soils formed mainly in reddish sandy loam till underlain by sand and gravel at various depths.

This complex is about 60 percent Amery sandy loam, 30 percent Cromwell sandy loam, and 10 percent other similar soils. Positions of these soils on the landscape vary, but the Amery soil is mainly on ridgetops and in slightly concave areas. The Amery soil is less eroded than the Cromwell soil, which is mainly on the crests of knolls and in convex areas.

The Amery soil has a profile similar to the one described as representative of the series, but in most places the surface layer is sandy loam rather than loam. Also, in some areas the sandy loam till is underlain by loamy sand or sand and gravel at a depth of 3 to 5 feet. The Cromwell soil has a profile similar to the one described as representative of the series.

Included with these soils in mapping are uneroded soils that have a surface layer of fine sandy loam, loam, or silt loam. Also included are areas of deep, dark, silty and loamy soils in drainageways; small areas of sand and gravel on the crests of knolls where the soil is severely eroded; some wet soils, ponds, and small lakes in sinks and depressions; and some short slopes that are less than 6 percent or more than 12 percent.

Runoff is medium, and the hazard of erosion is moderate. In most areas erosion has caused tilth to deteriorate and has reduced the content of organic matter in the surface layer.

Most areas of this complex are cultivated. These soils are moderately well suited mainly to oats, alfalfa, and grasses and poorly suited to row crops. Some row crops, mainly corn, are grown on the less sloping soils. The short slopes in the complex are well suited to red or white pine. Controlling erosion and soil blowing and maintaining tilth and organic matter content are important factors of good management. Capability unit IVe–4; woodland group 2o1.

AnD2—Amery-Cromwell sandy loams, 12 to 25 percent slopes, eroded. The soils in this complex are on end moraines and areas of pitted drift. Most areas are irregular in shape and range from 10 to 80 acres in size. These soils formed mainly in reddish sandy loam till that is underlain by sand and gravel at various depths.

This complex is about 45 percent Amery sandy loam, 35 percent Cromwell sandy loam, and 20 percent other soils. Positions of these soils in the landscape vary, but the Amery soil is mainly on ridgetops and in slightly concave areas. The Amery soil is less eroded than the Cromwell soil, which is mainly on crests of knolls and in convex areas.

The Amery soil has a profile similar to the one described as representative of the series, but in most places the surface layer is sandy loam rather than loam. Also, in some areas the sandy loam till is underlain by loamy sand or sand and gravel at a depth of 3 to 5 feet. The Cromwell soil has a profile similar to the one described as representative of the series.

Included with these soils in mapping are soils that have a surface layer of fine sandy loam, loam, or silt loam, and small areas of reddish clayey soils near ponds and small lakes. Also included are small areas of deep, dark, silty and loamy soils in drainageways; small areas on the crests of knolls where the soil is sandy and gravelly and severely eroded; areas of wet soils, ponds, and small lakes in sinks and depressions; and areas where slopes are less than 12 percent or more than 25 percent.

Runoff is rapid, and the hazard of erosion is severe.

In most areas erosion has caused tilth to deteriorate and has reduced the content of organic matter in the surface layer.

Most areas of this complex are in hay or pasture. These soils are generally unsuited to cultivated crops, but they are suited to pasture and hay. Slopes facing south and southwest are more droughty and less suited to trees than slopes facing north and northeast. Controlling erosion and maintaining organic matter content are important factors of good management. Capability unit VIe–4; woodland group 2r1.

Antigo Series

The Antigo series consists of nearly level to steep, well drained soils on stream terraces and outwash plains. These soils formed mainly in silty sediment that is underlain by sand and gravel. Native vegetation was mainly white pine, sugar maple, and red oak.

In a representative profile the surface layer is about 8 inches of dark grayish brown silt loam. The subsurface layer is brown silt loam about 10 inches thick. The subsoil is about 15 inches thick. It is dark yellowish brown, friable, heavy silt loam in the upper part, dark yellowish brown, friable loam in the middle part, and dark brown, very friable, heavy sandy loam in the lower part. The substratum, to a depth of 60 inches, is strong brown sand and gravel (fig. 2).

Available water capacity is moderate. Permeability ranges from moderate in the silty surface layer and upper part of the subsoil to very rapid in the underlying sand and gravel. Natural fertility is medium. The organic matter content of the surface layer is moderate.

Most areas of these soils are in corn. Some areas are used for soybeans and kidney or navy beans.

Representative profile of Antigo silt loam, 0 to 2 percent slopes, in a cultivated field in southwest corner of SE¼, sec. 25, T. 30 N., R. 19 W.:

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam; weak fine and medium subangular blocky structure; very friable; common roots; medium acid; abrupt smooth boundary.

A2—8 to 11 inches; brown (10YR 5/3) silt loam, pale brown (10YR 6/3) dry; moderate thick platy structure parting to weak fine subangular blocky; friable; common roots; medium acid; clear wavy boundary.

A&B—11 to 18 inches; brown (10YR 5/3) tongues of silt loam (A2); weak thin and medium platy structure; dark yellowish brown (10YR 4/4) slightly heavier silt loam (B21t); weak medium subangular blocky structure; friable; common roots; medium acid; clear irregular boundary.

B21t—18 to 25 inches; dark yellowish brown (10 YR 4/4) heavy silt loam; moderate medium subangular blocky structure; friable; uncoated silt and fine sand grains on faces of peds; thin patchy clay films; common roots; strongly acid; clear wavy boundary.

B22t—25 to 29 inches; dark yellowish brown (10 YR 4/4) loam; moderate medium subangular blocky structure; friable; thin patchy clay films; common roots; strongly acid; clear wavy boundary.

IIB3—29 to 33 inches; dark brown (7.5YR 4/4) heavy sandy loam; weak medium subangular blocky structure; very friable;

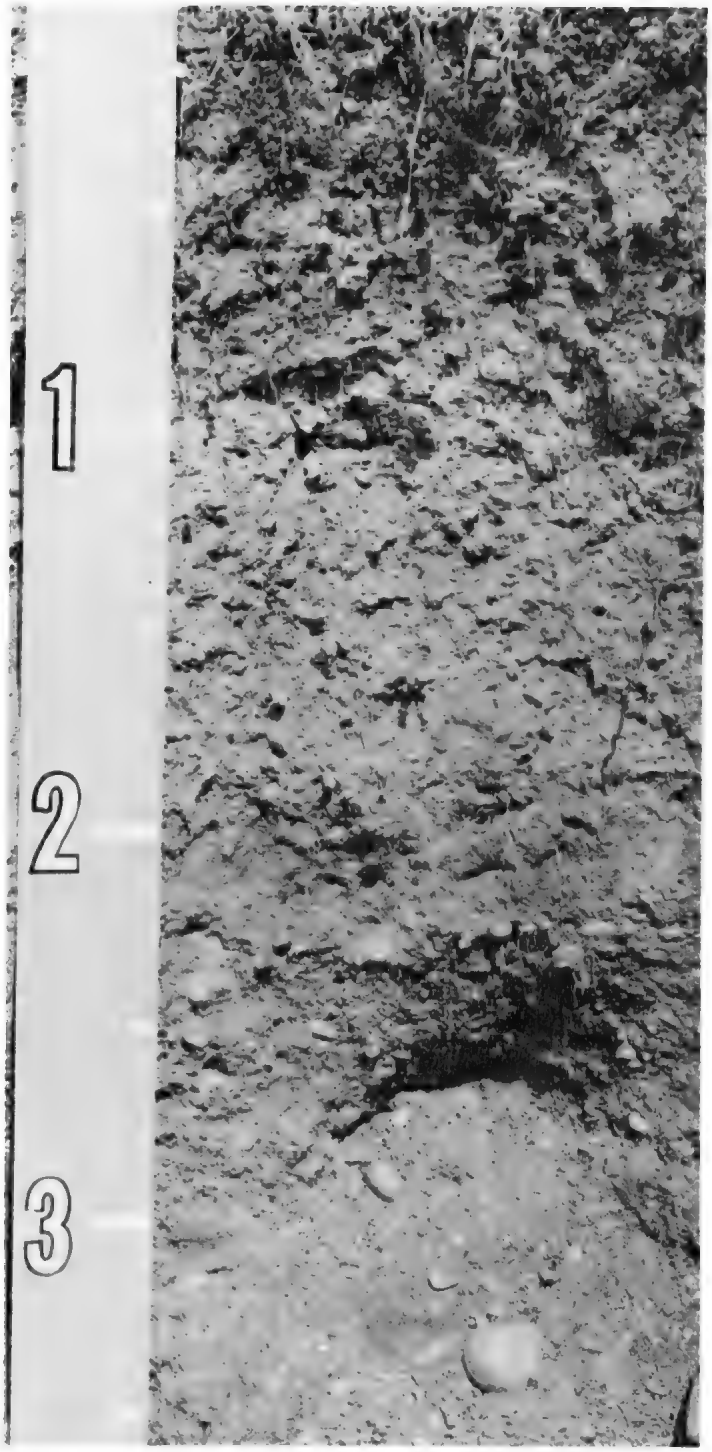


Figure 2.—**Profile of an Antigo silt loam. The underlying sand and gravel is at a depth of about 2½ feet.**

common pebbles; few roots; strongly acid; gradual wavy boundary.

IIC—33 to 60 inches; strong brown (7.5YR 5/6) sand and gravel; single grained; loose; strongly acid.

The solum thickness and depth to sand and gravel range from 20 to 40 inches. The silty mantle is 24 to 36 inches thick. The Ap horizon is very dark brown, dark brown, or dark grayish brown and 6 to 10 inches thick.

The Bt horizon is mainly silt loam or silty clay loam. The C horizon is 10 to 25 percent coarse fragments. This soil is strongly acid in the subsoil and substratum.

Antigo soils are near Onamia and Sattre soils. They contain more silt and less sand and have a thicker A2 horizon than Onamia and Sattre soils. Also, Antigo soils have a lighter colored A horizon than Sattre soils.

AoA—Antigo silt loam, 0 to 2 percent slopes. This soil is on outwash plains and stream terraces. Most areas are oblong and range from 10 to 100 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are a few areas of Onamia and Sattre soils. Also included are a few areas, mainly near the base of steeper slopes, where the silty mantle ranges from 3 to 5 feet in thickness.

Runoff is very slow, and the hazard of erosion is slight.

This soil is moderately well suited to corn and beans. Where this soil is in row crops year after year, the main concerns of management are maintaining fertility, tilth, and soil structure. Capability unit IIs–1; woodland group 2o1.

AoB—Antigo silt loam, 2 to 6 percent slopes. This soil is on outwash plains and stream terraces. Most areas are oblong and range from 10 to 120 acres in size.

This soil has a slightly thinner silty mantle than the one described as representative of the series, but otherwise the two profiles are similar.

Included with this soil in mapping are a few areas of Onamia and Sattre soils. Also included are a few areas, mainly near the base of steeper slopes, where the silty mantle ranges from 3 to 5 feet in thickness and a few areas where slopes are slightly more than 6 percent.

Runoff is slow, and the hazard of erosion is slight.

This soil is moderately well suited to corn, oats, and alfalfa. It is frequently used for corn and beans. Controlling erosion and maintaining fertility, tilth, and soil structure are important factors of good management, especially where this soil is frequently used for row crops. Capability unit IIe–2; woodland group 2o1.

Arland Series

The Arland series consists of gently sloping to very steep, well drained soils on ridges, foot slopes, and valley escarpments of sandstone uplands covered by a thin mantle of glacial drift. In most places these soils formed in a silty mantle and in the underlying loamy till. These soils are underlain by weathered sandstone bedrock. Native vegetation was mainly sugar maple, red oak, and white pine.

In a representative profile the surface layer is about 8 inches of very dark grayish brown silt loam. The subsurface layer is brown silt loam about 3 inches thick. The subsoil is about 24 inches thick. It is brown, friable silt loam in the upper part; brown, friable loam in the middle part; and strong brown, friable, heavy sandy loam in the lower part. The substratum, to a depth of 60 inches, is very pale brown, weakly cemented sandstone containing a few thin bands of loose fine sandy loam.

Available water capacity is moderate but ranges to low. Permeability is moderate. Natural fertility is medium but ranges to low in a few areas. The organic matter content of the surface layer is low or moderate.

Most areas of these soils that are gently sloping or sloping are in corn, oats, and alfalfa. Steeper areas of these soils are used mainly for pasture or woodland.

Representative profile of Arland silt loam, 2 to 6 percent slopes, in a cultivated area, 440 yards east and 220 yards south of northwest corner of the SW¼ of sec. 18, T. 28 N., R. 16 W.:

Ap—0 to 8 inches; very dark grayish brown (10 YR 3/2) silt loam, light brownish gray (10YR 6/2) dry; weak medium subangular blocky structure; friable; many roots; neutral; abrupt smooth boundary.

A2—8 to 11 inches; brown (10YR 4/3) silt loam; moderate thin and medium platy structure; friable; common roots; neutral; abrupt wavy boundary.

B1—11 to 15 inches; brown (7.5YR 4/4) silt loam; moderate fine subangular blocky structure; friable; common roots; neutral; clear wavy boundary.

B21t—15 to 19 inches; brown (7.5YR 4/4) loam, high sand content; moderate medium subangular blocky structure; friable; thin patchy clay films on ped faces; common roots; slightly acid; clear wavy boundary.

IIB22t—19 to 26 inches; brown (7.5YR 4/4) loam; moderate medium subangular blocky structure; friable; thin patchy clay films on ped faces; common roots; about 10 percent coarse fragments by volume; strongly acid; clear wavy boundary.

IIIB3—26 to 35 inches; strong brown (7.5YR 5/6) heavy sandy loam; weak medium and coarse subangular blocky structure; friable; few roots; about 10 percent coarse fragments by volume; strongly acid; clear wavy boundary.

Cr—35 to 60 inches; very pale brown (10YR 8/4 and 10YR 7/4) soft, weakly cemented sandstone containing a few, thin bands of yellowish red (5YR 5/6) fine sandy loam; single grained where disturbed by digging; loose; strongly acid.

The solum thickness and depth to sandstone bedrock range from 24 to 40 inches. The silty mantle is less than 25 inches thick. The Ap horizon is dark brown, very dark grayish brown or dark grayish brown silt loam or sandy loam 6 to 10 inches thick. In uncultivated areas, the A horizon is very dark brown, very dark gray, or black and 2 to 6 inches thick.

The IIBt horizon is heavy sandy loam, loam, or sandy clay loam. The B horizon is 5 to 20 percent coarse fragments. In many places a cobbly and gravelly band is in

the lower part of the B horizon. The C horizon is sand weathered from sandstone and weakly cemented sandstone. These soils are strongly acid or very strongly acid in the B horizon and strongly acid to slightly acid in the C horizon.

Arland soils are near Santiago, Skyberg, and Vlasaty soils. They are underlain by sandstone rather than the reddish sandy loam till typical of Santiago soils or the heavy loam or clay loam till typical of Skyberg and Vlasaty soils. Arland soils are well drained but Skyberg soils are somewhat poorly drained.

ApC2—Arland sandy loam, 6 to 12 percent slopes, eroded. This soil is on knolls and valleys of sandstone uplands that are covered by a thin mantle of glacial drift. Most areas are elongated or oblong and range from 5 to 80 acres in size.

This soil has a profile similar to the one described as representative of the series, but the surface layer and subsoil contain more sand and less clay.

Included with this soil in mapping are a few areas where the subsoil is mainly sandy loam. Also included are a few areas where the substratum is loamy or clayey, a few areas where the surface layer is loamy fine sand, loam, or silt loam, and a few areas where slopes are less than 6 percent or more than 12 percent.

Runoff is medium, and the hazard of erosion is moderate. This soil is subject to soil blowing. In most cultivated areas, erosion has caused deterioration of tilth and reduced the content of organic matter in the surface layer. Available water capacity is low but ranges to moderate in a few places. Permeability of the underlying residuum is moderate in most places but ranges to moderately slow in a few areas where residuum has bands of heavier textured material.

This soil is suited to row crops, oats, and alfalfa. It is used frequently for hay, pasture, and trees. Controlling erosion and maintaining tilth are important factors of good management. Capability unit IIIe–7; woodland group 2o1.

ApD2—Arland sandy loam, 12 to 25 percent slopes, eroded. This soil is on knolls and valley escarpments of sandstone uplands that are covered by a thin mantle of glacial drift. Most areas are elongated or oblong and range from 5 to 120 acres in size.

This soil has a profile similar to the one described as representative of the series, but the surface layer and subsoil contain more sand and less clay. Also, in many areas, the depth to sandy residuum is less.

Included with this soil in mapping are a few areas where the subsoil consists mainly of fine sandy loam. Also included are a few areas where the substratum is loamy or clayey and a few areas where the surface layer is loamy fine sand, loam, or silt loam.

Runoff is rapid, and the hazard of erosion is severe. This soil is subject to soil blowing. In cultivated areas, erosion has caused deterioration of tilth and reduced organic matter content in the surface layer. Available water capacity is low but ranges to moderate in a few places. Permeability of the residuum is variable, but is moderate in most areas. Fragments of bedrock are common in some areas.

This soil is moderately well suited to hay and pasture. It is poorly suited to row crops. It is frequently used for pasture and growing trees. Controlling erosion and maintaining tilth and organic matter content are important factors of good management. Capability unit IVe–7; woodland group 2r1.

ApF—Arland sandy loam, 25 to 35 percent slopes. This soil is on sandstone and limestone uplands where the mantle of glacial drift is thin or lacking. Most areas are elongated or irregular in shape and range from 10 to 100 acres in size.

This soil has a profile similar to the one described as representative of the series, but the surface layer and subsoil contain more sand, and the substratum contains more silt and clay.

Included with this soil in mapping are many areas where the subsoil consists mainly of loamy material weathered from shaly sandstone or sandy limestone. Also included are a few small areas of Boone and Ritchey soils, a few areas where the surface layer is loam or silt loam that contains many sandstone and limestone fragments, and a few small areas where slopes are less than 25 percent or more than 35 percent.

Runoff is very rapid, and the hazard of erosion is very severe. The available water capacity is moderate but ranges to low in a few places. Permeability ranges to moderately slow in the stratified, loamy parts of the substratum.

This soil is unsuited to cultivated crops. Many areas are in pasture or woodland. Slopes facing south, and southwest facing slopes are less suited to trees than slopes facing north and northeast. Controlling erosion and maintaining tilth and organic matter content are important factors of good management. Capability unit VIIe–2; woodland group 2r1.

AsB—Arland silt loam, 2 to 6 percent slopes. This soil is on low ridges of ground moraines that are underlain by sandstone. Most areas are oblong and range from 5 to 30 acres in size. This soil has the profile described as representive of the series.

Included with this soil in mapping are a few areas where the surface layer is loam. Also included are some areas of Arland soils that have a loamy substratum and a few areas where slopes are less than 2 percent or more than 6 percent.

Runoff is slow, and the hazard of erosion is slight.

This soil is moderately well suited to corn, oats, and alfalfa. Controlling erosion is an important factor of good management. Capability unit IIe–2; woodland group 2o1.

AsC2—Arland silt loam, 6 to 12 percent slopes, eroded. This soil is on morainic uplands that are underlain by sandstone. Most areas are elongated or oblong and range from 5 to 20 acres in size.

In most areas this soil has a lighter colored surface layer and thinner subsoil than the soil described as representative of the series, but otherwise the profiles are similar.

Included with this soil in mapping are areas where the surface layer is sandy loam. Also included are areas of Arland soils where the substratum is loamy, and a few areas where slopes are less than 6 percent or more than 12 percent.

Runoff is medium, and the hazard of erosion is moderate. In most areas, erosion of the surface layer has caused deterioration of its tilth.

This soil is suited to oats, grasses, and a limited amount of corn. It is frequently used for hay and pasture. Controlling erosion and maintaining tilth and or-

ganic matter content are important factors of good management. Capability unit IIIe–2; woodland group 2o1.

Auburndale Series

The Auburndale series consists of nearly level and gently sloping, poorly drained soils in drainageways and depressions of low ground moraines. These soils formed mainly in silty sediment and in the underlying sandy loam till. Native vegetation was lowland hardwoods, mainly ash, elm, and soft maple. Unless these soils are drained, water is at or near the surface throughout the year.

In a representative profile the surface layer is very dark gray silt loam about 4 inches thick. The subsurface layer is about 9 inches of dark grayish brown and grayish brown silt loam. The subsoil is about 27 inches thick. It is grayish brown, friable and firm, mottled, heavy silt loam in the upper part and strong brown, friable, mottled sandy loam in the lower part. The substratum, to a depth of about 60 inches, is strong brown, friable, mottled sandy loam.

Available water capacity is high, and permeability is moderately slow. Natural fertility is medium. The organic matter content of the surface layer is moderate. Depth of the root zone is limited for major farm crops by a perched water table.

Most areas of these soils are used for pasture or woodland. Some areas that are adequately drained and protected from runoff and ponding are used for row crops.

Representative profile of Auburndale silt loam, 0 to 3 percent slopes, in an uncultivated area, 330 yards south and 150 yards east of northwest corner of sec. 22, T. 29 N., R. 15 W.:

A1—0 to 4 inches; very dark gray (10YR 3/1) silt loam; moderate medium granular structure; friable; many roots; slightly acid; abrupt smooth boundary.

A2g—4 to 8 inches; dark grayish brown (10YR 4/2) silt loam; moderate thin and medium platy structure; friable; grayish brown (10YR 5/2) uncoated silt grains on faces of peds; very friable; common roots; medium acid; abrupt smooth boundary.

A&Bg—8 to 13 inches; grayish brown (10YR 5/2) silt loam (A2); moderate medium platy structure; brown (10YR 5/3) silt loam in a few ped interiors (B21t); weak medium subangular blocky structure; friable; common roots; strongly acid; abrupt wavy boundary.

B21tg—13 to 18 inches; grayish brown (10YR 5/2) heavy silt loam; few medium prominent strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; friable; few thin patchy clay films; common roots; friable; very strongly acid; clear wavy boundary.

B22tg—18 to 36 inches; grayish brown (2.5Y 5/2) heavy silt loam; few medium prominent yellowish brown (10YR 5/6) mottles; moderate coarse subangular blocky structure; firm; thin patchy clay films; few roots; strongly acid; clear wavy boundary.

IIB3—36 to 40 inches; strong brown (7.5YR 5/6) sandy loam; common medium distinct grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; friable; about 15 percent coarse fragments by volume; neutral; clear wavy boundary.

IIC—40 to 60 inches; strong brown (7.5YR 5/6) sandy loam; common medium prominent grayish brown (10YR 5/2) mottles; massive; friable; contains bands of sand and gravel; about 5 percent coarse fragments by volume; neutral.

The solum and silty sediment range from 30 to 48 inches in thickness. Coarse fragments occur throughout the silty sediment in some places. The A1 horizon is black, very dark brown, very dark gray, or dark gray silt loam and 3 to 6 inches thick.

The C horizon is sandy loam or loam. It is 5 to 15 percent coarse fragments. These soils are strongly acid or very strongly acid in the B horizon and slightly acid to neutral in the C horizon.

Auburndale soils are near Adolph, Rib, and Skyberg soils. They have a B horizon that is mainly heavy silt loam but in Skyberg soils it is mainly heavy loam. Also, Auburndale soils are more poorly drained than Skyberg soils. They have a thicker silty mantle than Adolph soils. They are underlain by loamy till and drift rather than the sand and gravel typical of Rib soils.

AuA—Auburndale silt loam, 0 to 3 percent slopes. This soil is in narrow to moderately broad drainageways and depressions of low ground moraines.

Included with this soil in mapping are small areas of Adolph, Rib, and Skyberg soils. Also included are a few areas where the substratum is a heavy loam or clay loam rather than sandy loam.

Runoff is slow or ponded. This soil is subject to ponding or flooding by runoff water in spring and during wet seasons.

Most areas of this soil are used for pasture. If adequately drained and if excess runoff is removed, this soil is moderately well suited to corn or other row crops. Capability unit IIIw–3; woodland group 3w2.

Boone Series

The Boone series consists of gently sloping to moderately steep, excessively drained soils of the sandstone uplands. These sandy soils are underlain by weakly cemented sandstone. Native vegetation was oak savanna.

In a representative profile the surface layer is about 3 inches of black loamy fine sand and about 2 inches of dark brown fine sand. The subsoil is yellowish brown, very friable fine sand about 19 inches thick. The substratum, to a depth of about 50 inches, is a light yellowish brown loose fine sand and sandstone fragments. Below this it is white weakly cemented sandstone to a depth of 60 inches.

Available water capacity is low, and permeability is very rapid in the surface layer and subsoil and moderately rapid in the substratum. Natural fertility and the organic matter content of the surface layer are low.

These soils are used mainly for woodland, pine tree plantations, and wildlife habitat.

Representative profile of Boone loamy fine sand, 6 to 12 percent slopes, in a pine plantation, 300 yards south and 50 yards east of northwest corner of sec. 24, T. 28 N., R. 18 W.:

A1—0 to 3 inches; black (10YR 2/1) loamy fine sand; very weak medium and coarse granular structure; very friable; common roots; very strongly acid; clear wavy boundary.

A3—3 to 5 inches; dark brown (10YR 4/3) fine sand; very weak medium and coarse granular structure parting to single grained where disturbed; very friable; common roots; very strongly acid; clear wavy boundary.

B2—5 to 24 inches; yellowish brown (10YR 5/4) fine sand; weak medium and coarse granular structure parting to single grained where disturbed; very friable; few roots; very strongly acid; clear wavy boundary.

C1—24 to 50 inches; light yellowish brown (10YR 6/4) fine sand and sandstone fragments; single grained; loose; few roots; strongly acid; clear wavy boundary.

C2—50 to 60 inches; white (10YR 8/2) soft weakly cemented sandstone breaking to sand where dug; single grained; loose; common coarse sandstone fragments; very strongly acid.

The solum ranges from 10 to 30 inches in thickness. Depth to soft sandstone ranges from 24 to 40 inches. Where it is not cultivated, the A1 horizon is black to very dark gray loamy fine sand or fine sand 2 to 4 inches thick. Where it is cultivated, the Ap horizon is dark grayish brown to dark yellowish brown and 6 to 10 inches thick.

The C horizon is fine sand or very weakly cemented sandstone in the upper part, becoming more strongly cemented as depth increases. These soils are strongly acid or very strongly acid in the B and C horizons.

Boone soils are near Arland, Hesch, and Nickin soils. They contain much more sand and less clay than those soils. Their B horizon formed in sandy residuum rather than the loamy residuum and loamy till typical of Arland soils. They have a thinner, lighter colored A horizon and their B and C horizons formed in residuum that contains more sand than Hesch soils. Boone soils have a thinner, lighter colored A horizon than Nickin soils and their B and C horizons formed in sandy residuum rather than the loamy mixture of till and residuum weathered from sandstone typical of the Nickin soils.

BnB—Boone loamy fine sand, 2 to 6 percent slopes. This soil is on foot slopes of sandstone uplands. Most areas are oblong and range from 5 to 40 acres in size.

This soil has a profile similar to the one described as representative of the series, but the surface layer is thicker and lighter colored and the soil is deeper to cemented sandstone bedrock.

Included with this soil in mapping are areas where the surface layer is thick, dark colored loamy fine sand or fine sand. Also included are a few areas of sandy soils that are underlain by limestone bedrock at a depth of 2 to 4 feet.

Runoff is very slow, and the hazard of erosion is slight. This soil is subject to soil blowing.

This soil is poorly suited to row crops, but it is used for alfalfa, grasses, and pine tree plantations. Crop yields during most seasons are limited by low available water capacity. Controlling soil blowing is the main concern of management. Capability unit IVs–3; woodland group 3s1.

BnC—Boone loamy fine sand, 6 to 12 percent slopes. This soil is on foot slopes of the standstone uplands. Most areas are oblong and range from 5 to 80 acres in size.

This soil has the profile described as representative of the series. Some areas have been cleared; and, as a result of cultivation and erosion, some of the subsoil has been mixed into the plow layer.

Included with this soil in mapping are a few areas of shallow sandy soils over strongly cemented sandstone or limestone.

Runoff is slow, and the hazard of erosion is slight. This soil is subject to soil blowing. The main concerns of management are controlling erosion and soil blowing.

This soil is generally unsuitable for row crops but is used for alfalfa, grasses, and pine tree plantations. Crop yields during most seasons are limited by low available water capacity. Capability unit VIs–3; woodland group 3s1.

BnD—Boone loamy fine sand, 12 to 20 percent slopes. This soil is on the knolls and ridges of the sandstone uplands. Most areas are oblong or round and range from 5 to 100 acres in size.

This soil has a profile similar to the one described as representative of the series, but the surface layer is thinner and lighter colored, and depth to cemented sandstone bedrock is a few inches less.

Included with this soil in mapping are a few small areas of shallow sandy soils over strongly cemented sandstone or limestone.

Runoff is medium, and the hazard of erosion is moderate. This soil is subject to soil blowing.

This soil is unsuitable for row crops. It is best suited to pine trees. The main concerns of management are controlling erosion and soil blowing. Pasture and tree yields are limited by low available water capacity. Capability unit VIIs–3; woodland group 3s3.

Brill Series

The Brill series consists of nearly level and gently sloping, moderately well drained soils on stream terraces and outwash plains. These soils formed mainly in silty sediment underlain by acid sand and gravel. Native vegetation was mainly such northern hardwoods as red maple, sugar maple, basswood, and ash.

In a representative profile the surface layer is about 9 inches of very dark grayish brown silt loam. The subsurface layer is mainly brown silt loam about 7 inches thick. The subsoil is about 14 inches thick. It is yellowish brown, friable silt loam in the upper part; dark brown, friable, mottled silt loam in the middle part; and dark brown, friable, mottled loam in the

lower part. The substratum, to a depth of about 60 inches, is yellowish brown sand and gravel.

Available water capacity is moderate, and permeability ranges from moderate in the silty subsoil to rapid in the underlying sand and gravel. Natural fertility is medium. The organic matter content of the surface layer is moderate.

Most areas of these soils are used for corn, alfalfa, and grasses.

Representative profile of Brill silt loam, 0 to 3 percent slopes, in a cultivated field, 450 yards west and 95 yards north of center of sec. 12, T. 31 N., R. 15 W.:

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, light brownish gray (10YR 6/2) dry; weak fine and medium subangular blocky structure; friable; common roots; neutral; abrupt smooth boundary.

A&B—9 to 16 inches; brown (10YR 5/3) tongues of silt loam (A2); moderate thin platy structure; yellowish brown (10YR 5/4) slightly heavier silt loam (B); weak fine subangular blocky structure; very friable; common roots; slightly acid; clear wavy boundary.

B&A—16 to 20 inches; yellowish brown (10YR 5/4) silt loam (B21t); moderate fine subangular blocky structure; penetrated by brown (10YR 5/3) tongues of silt loam (A2); weak thin platy structure; friable; common roots; very strongly acid; clear wavy boundary.

B21t—20 to 26 inches; dark brown (7.5YR 4/4) silt loam, high sand content; few fine distinct strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; friable; thin patchy clay films; common roots; very strongly acid; clear wavy boundary.

IIB3t—26 to 30 inches; dark brown (7.5YR 4/4) loam, high sand content; common medium and coarse distinct strong brown (7.5YR 5/6) and few medium distinct dark grayish brown (10YR 4/2) mottles; moderate medium and coarse subangular blocky structure; friable; thin patchy clay films; common roots; strongly acid; clear smooth boundary.

IIC—30 to 60 inches; yellowish brown (10YR 5/6) sand and gravel; single grained; loose; medium acid.

The solum thickness and depth to sand and gravel range from 25 to 35 inches. The silty mantle ranges from 20 to 30 inches in thickness. The Ap horizon is very dark grayish brown, very dark brown, or dark grayish brown.

The C horizon is 10 to 25 percent coarse fragments. These soils are strongly acid or very strongly acid in the B horizon and medium acid in the C horizon.

Brill soils are near Antigo and Halder soils. They are more poorly drained than Antigo soils, but they are less poorly drained than Halder soils.

BpA—Brill silt loam, 0 to 3 percent slopes. This soil is in narrow to moderately broad areas on stream terraces and outwash plains. Most areas are elongated and range from 8 to 20 acres in size.

Included with this soil in mapping are some areas where the subsoil is heavy loam or clay loam. Also included are some areas of Antigo and Halder soils. Some of the included Halder soils are less poorly drained than is typical for that soil.

Runoff is slow, and the hazard of erosion is slight. Tillage is delayed for relatively long periods because this soil remains saturated early in spring and after heavy rain.

This soil is moderately well suited to most of the commonly grown crops, such as corn, oats, and alfalfa-brome hay. The main concerns of management are maintaining tilth and soil structure and removing surface water. Capability unit IIs–1; woodland group 2o1.

Burkhardt Series

The Burkhardt series consists of nearly level to steep, somewhat excessively drained soils on stream terraces, outwash plains, and areas of pitted outwash plains. These soils formed in sandy loam sediment underlain by sand and gravel. Native vegetation was mainly oak savanna or native prairie grasses.

In a representative profile the surface layer is about 12 inches thick. It is very dark brown, very dark grayish brown, and dark yellowish brown sandy loam. The subsoil is about 8 inches thick. It is brown, friable sandy loam in the upper part and brown, very friable loamy sand in the lower part. The substratum, to a depth of about 60 inches, is brownish yellow sand and gravel.

Available water capacity is low, and permeability ranges from moderately rapid in the loamy upper part to rapid in the underlying sand and gravel. Natural fertility is low. The organic matter content of the surface layer is low or moderate.

Most areas of these soils are in hay, pasture, or woodland. A few nearly level and gently sloping soils are used for corn, soybeans, and garden vegetables. Where these soils are irrigated and fertilized, they are well suited to potatoes and other special crops. Areas of Burkhardt soils are a good source of sand and gravel.

Representative profile of Burkhardt sandy loam, 6 to 12 percent slopes, eroded, in a cultivated field, 320 yards south of northwest corner of sec. 32, T. 31 N., R. 18 W.:

Ap—0 to 8 inches; very dark brown (10YR 2/2) sandy loam; weak medium subangular blocky structure parting to weak fine granular; very friable; many roots; medium acid; abrupt smooth boundary.

A12—8 to 10 inches; very dark grayish brown (10YR 3/2) sandy loam; weak medium subangular blocky structure; very friable; many roots; medium acid; clear smooth boundary.

A3—10 to 12 inches; dark yellowish brown (10YR 3/4) sandy loam; weak medium subangular blocky structure; very friable; many roots; strongly acid; clear smooth boundary.

B2—12 to 16 inches; brown (7.5YR 4/4) sandy

loam; weak medium and coarse subangular blocky structure; friable; strongly acid; clear wavy boundary.

B3—16 to 20 inches; brown (7.5YR 4/4) loamy sand; weak very fine subangular blocky structure; very friable, about 15 percent coarse fragments by volume; strongly acid; clear wavy boundary.

IIC—20 to 60 inches; brownish yellow (10YR 6/6) sand and gravel; about 25 percent coarse fragments by volume; loose; medium acid.

The solum thickness and depth to sand and gravel range from 12 to 24 inches. The A horizon is dark reddish brown, very dark brown, or black. It is 6 to 20 inches thick.

The B horizon is sandy loam or light loam. The C horizon is mostly sand and gravel that originated mainly from igneous or metamorphic rock. It is 20 to 45 percent coarse fragments. The B horizon is strongly acid or medium acid, and the C horizon is medium acid or slightly acid.

Burkhardt soils are near Dakota and Sattre soils. They are not so deep to sand and gravel, and they contain more sand and less silt and clay than Sattre soils. Also, they are not so deep to sand and gravel, their A horizon is not so thick, and they contain less silt and clay than is typical for Dakota soils.

BrB—Burkhardt sandy loam, 1 to 6 percent slopes. This soil is on outwash plains and stream terraces. Most areas are elongated or irregular in shape and range from 10 to 80 acres in size.

This soil has a profile similar to the one described as representative of the series, but its surface layer is darker colored.

Included with this soil in mapping are some areas in drainageways where the surface layer is loam or silt loam. Also included are small areas of steeper Emmert soils.

Runoff is slow, and the hazard of erosion is slight. The hazard of soil blowing is moderate.

This soil is suited to soybeans, corn, grasses, and alfalfa. Crop yields are generally limited by low available water capacity. Where irrigated and fertilized this soil is well suited to corn, potatoes, and other row crops. Controlling erosion and soil blowing are important factors of good management. Capability unit IIIe–3; woodland group 3d1.

BrC2—Burkhardt sandy loam, 6 to 12 percent slopes, eroded. This soil is on knolls of river terraces and pitted outwash areas. Most areas are oblong and range from 5 to 30 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Emmert soils and small areas in natural drainageways where the surface layer is loam or silt loam.

Runoff is medium, and the hazards of erosion and soil blowing are moderate. In most areas erosion and soil blowing have caused tilth to deteriorate and have reduced the content of organic matter in the surface layer.

This soil is poorly suited to row crops. It is suited to grasses, alfalfa, or pine tree plantations. Crop yields are generally limited by low available water capacity. Controlling erosion and soil blowing and maintaining organic matter content are important factors of good management. Capability unit IVe–3; woodland group 3d1.

BxB—Burkhardt-Sattre complex, 2 to 6 percent slopes. The soils in this complex are on outwash plains and stream terraces. Most areas are irregular in shape and range from 10 to 60 acres in size.

This complex is about 40 percent Burkhardt sandy loam, 35 percent Sattre loam and silt loam, and 25 percent other soils, mainly Pillot and Dakota soils. The Burkhardt soil is mainly on or near the crests of knolls and in the steeper, more eroded parts of the complex. The Sattre soils are on slightly concave, less eroded parts of knolls, drainageways, and depressions. Pillot and Dakota soils are in some drainageways, depressions, and concave areas.

Included with these soils in mapping are a few areas where the loam or silt loam extends to a depth of 5 feet or more. Also included are small areas on the crests of knolls where the surface layer is sandy and gravelly and the soil is severely eroded; and a few small areas where slopes are less than 2 percent or more than 6 percent.

Runoff is slow, and the hazard of erosion is slight. Soil blowing is a moderate hazard on Burkhardt soils.

Most areas of this complex are cultivated. These soils are suited to corn, oats, and alfalfa. In many areas crop yields are limited by low available water capacity. Controlling erosion and maintaining organic matter content are important factors of good management. Capability unit IIIe–3; woodland group 3d1.

BxC2—Burkhardt-Sattre complex, 6 to 12 percent slopes, eroded. The soils in this complex are on pitted outwash plains and stream terraces. Most areas are irregular in shape and range from 10 to 200 acres in size.

This complex is about 50 percent Burkhardt sandy loam and loam, 30 percent Sattre silt loam and loam, and 20 percent other soils, mainly Pillot and Dakota soils. The Burkhardt soils are mainly near the crests of knolls and on steeper, more eroded parts of this complex. The Sattre soils are mainly on concave, less eroded parts of the knolls, depressions, and drainageways. Pillot and Dakota soils are in some depressions and drainageways.

The Burkhardt soils have a profile similar to the one described as representative of the series, but the surface layer is slightly thinner and lighter colored. The Sattre soils in many of the depressions and drainageways have a profile similar to the one described as representative of the series, but the surface layer is slightly thicker and darker colored.

Included with these soils in mapping are a few areas where the soil is gravelly and sandy and severely eroded, and a few areas of wet soils. Also included are a few small, steep areas of Emmert loamy sand and a few small areas where slopes are less than 6 percent or more than 12 percent.

Runoff is medium, and the hazard of erosion is moderate. Burkhardt soils are subject to soil blowing. Erosion and soil blowing have caused tilth to deteriorate and have reduced the organic matter content in the surface layer.

This complex is suited mainly to grasses and alfalfa, but some corn and soybeans are also grown. In many

areas crop yields are limited by low available water capacity. Controlling erosion and soil blowing and maintaining tilth and organic matter content are important factors of good management. Areas of this complex are good sources of sand and gravel. Capability unit IVe–3; woodland group 3d1.

BxD2—Burkhardt-Sattre complex, 12 to 30 percent slopes, eroded. The soils in this complex are on pitted outwash plains. This complex is about 60 percent Burkhardt sandy loam and loam, 20 percent Sattre loam and silt loam, and 20 percent other soils, mainly Dakota, Pillot, and Chetek soils. The Burkhardt soils are mainly near the crest of knolls and on steeper, more eroded parts of this complex. The Sattre soils are mainly on concave, less eroded parts of knolls, drainageways, and depressions. Dakota and Pillot soils are in some drainageways, depressions, and concave areas, and Chetek soils are on eroded knolls.

The Burkhardt soils have a profile similar to the one described as representative of the series, but the surface layer is slightly thinner and lighter colored. The Sattre soils in many drainageways and depressions have a profile similar to the one described as representative of the series, but the surface layer is slightly thicker and darker colored.

Included with these soils in mapping are a few areas where the soil is gravelly and sandy and severely eroded, and a few areas of wet soils. Also includued are a few small areas of Emmert loamy sand and a few small areas where slopes are less than 12 percent or more than 30 percent.

Runoff is rapid, and the hazard of erosion is severe. In most places, erosion has caused tilth to deteriorate and has reduced the content of organic matter in the surface layer. In areas of more severely eroded soils, coarse fragments are on the surface.

Most areas of this complex are used for pasture and are suited to grass and alfalfa. A few areas are wooded. Most areas are well suited to red and white pine. In most areas tree growth and pasture yields are limited by low available water capacity. Slopes facing south and southwest are more droughty and tree growth is less than on slopes facing north and northeast. Controlling erosion and maintaining tilth and organic matter content are important factors of good management. Capability unit VIe–3; woodland group 3d2.

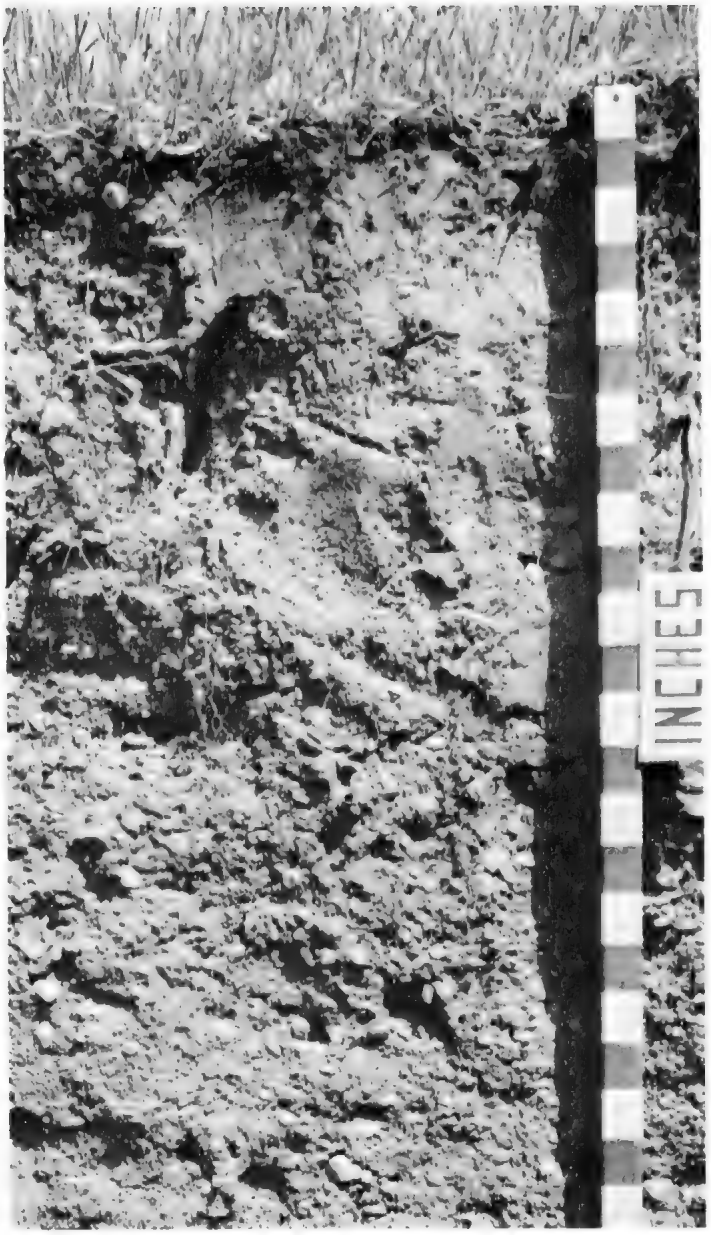


Figure 3.—**Profile of a Chetek sandy loam that shows sand and gravel at a depth of about 14 inches.**

Chetek Series

The Chetek series consists of sloping to steep, somewhat excessively drained soils on knolls of pitted outwash plains. These soils formed in sandy loam material underlain by sand and gravel. Native vegetation was mainly red oak and white pine.

In a representative profile the surface layer is dark brown sandy loam about 6 inches thick (fig. 3). The subsoil is about 13 inches thick. In the upper part it is brown, friable heavy sandy loam and in the lower part it is brown, very friable loamy sand. The substratum, to a depth of about 60 inches, is strong brown sand and gravel.

Available water capacity is low, and permeability is moderately rapid in the subsoil and rapid in the substratum. Natural fertility and the organic matter content of the surface layer are low.

Most areas of these soils are used for pasture, hay, or trees.

In this county, Chetek soils are mapped only in complex with Onamia soils.

Representative profile of Chetek sandy loam in an area of Chetek–Onamia complex, 12 to 20 percent slopes, eroded, 280 yards north and 70 yards west of center of sec. 1, T. 29 N., R. 20 W.:

Ap—0 to 6 inches; dark brown (10YR 3/3) sandy loam; weak medium granular structure; very friable; common roots; medium acid; abrupt smooth boundary.

Bt—6 to 16 inches; brown (7.5YR 4/4) heavy

sandy loam; moderate coarse and medium subangular blocky structure; friable; common roots; thin patchy clay films on faces of ped; medium acid; clear wavy boundary.

B3—16 to 19 inches; brown (7.5YR 4/4) loamy sand; weak coarse subangular blocky structure; very friable; about 15 percent coarse fragments by volume; medium acid; clear wavy boundary.

C—19 to 60 inches; strong brown (7.5YR 5/6) sand and gravel; single grained; loose; about 25 percent coarse fragments by volume; slightly acid.

The solum thickness and depth to sand and gravel range from 12 to 24 inches. The Ap horizon is very dark grayish brown, dark grayish brown or brown. In uncultivated, wooded areas the A1 horizon is very dark brown and less than 4 inches thick. The C horizon is 25 to 35 percent coarse fragments.

Chetek soils are near Antigo and Onamia soils. They are shallower to sand and gravel and they contain more sand than Onamia soils. Also, Chetek soils are shallower to sand and gravel and they lack the silty mantle typical of Antigo soils.

CoC2—Chetek-Onamia complex, 6 to 12 percent slopes, eroded. The soils in this complex are on pitted outwash plains. Most areas are irregular in shape and range from 10 to 200 acres in size. The surface layer in this complex is mainly sandy loam and loam, but in some small areas it is silt loam and loamy sand.

This complex is about 55 percent Chetek sandy loam and 45 percent Onamia sandy loam and loam. The Chetek soil is mainly near the crests of knolls. In most places it is more eroded than the Onamia soils, which are near drainageways and on concave parts of knolls.

The Chetek soil has a profile similar to the one described as representative of the series, but the subsoil is slightly thicker. The Onamia soils have a profile similar to the one described as representative of the series, but the surface layer and subsoil contain slightly more sand.

Included with these soils in mapping are wet soils in depressions, and areas of loams and sandy loams where most of the subsoil formed in silty glacial drift or in reddish colored sandy loam and loam till that is underlain by sand and gravel. Also included are a few small areas where the soil is sandy and gravelly and severely eroded, and a few small areas where slopes are less than 6 percent or more than 12 percent.

Runoff is medium, and the hazard of erosion is moderate. Chetek soils are subject to soil blowing. In most places erosion has caused tilth to deteriorate and has reduced the content of organic matter in the surface layer.

Most areas of this complex are in pasture and hay. These soils are suited mainly to oats, alfalfa, and grasses, but some corn and soybeans are also grown. In many areas crop yields are limited by low available water capacity. Controlling erosion and soil blowing and maintaining tilth and organic matter content are important factors of good management. Capability unit IVe–3; woodland group 3d1.

CoD2—Chetek-Onamia complex, 12 to 20 percent slopes, eroded. The soils in this complex are on pitted outwash plains. Most areas are irregular in shape and range from 10 to 150 acres in size. The surface layer in this complex is mainly loam and sandy loam but ranges from silt loam to loamy sand in small areas.

This complex is about 65 percent Chetek sandy loam and 35 percent Onamia sandy loam and loam. The Chetek soil is mainly near the crests of knolls. In most places the Chetek soil is more eroded than the Onamia soils, which are near drainageways and on slightly concave parts of knolls.

The Chetek soil has the profile described as representative of the series. The Onamia soils have a profile similar to the one described as representative of the series, but the surface layer and subsoil contain more sand, and in many areas the soils are more eroded and thinner.

Included with these soils in mapping are a few spots of wet soils in depressions and drainageways, and areas that have a thin mantle of reddish colored silt loam, loam, or sandy loam glacial drift that is underlain by sand and gravel at a depth of 3 to 5 feet. Also included are a few areas where slopes are less than 12 percent or more than 20 percent.

Runoff is rapid, and the hazard of erosion is severe. In most cleared and cultivated areas erosion has caused tilth to deteriorate and has reduced the content of organic matter in the surface layer. Small cobbles and pebbles are on the surface of the more severely eroded soils.

Most areas of this complex are in pasture. A few extensive areas are wooded. This complex is suited to alfalfa, grasses, or red and white pine. In many areas crop yields and tree growth are limited by low available water capacity. Slopes facing south and southwest are more droughty and less suited to trees than slopes facing north and northeast. Controlling erosion and maintaining organic matter content are important factors of good management. Capability unit VIe–3; woodland group 3d2.

CoE—Chetek-Onamia complex, 20 to 30 percent slopes. The soils in this complex are steep and on pitted outwash plains. The surface layer is mainly sandy loam and loam, but in some areas it ranges from loamy sand to silt loam. In some of the draws, depressions, and drainageways the surface layer is dark colored.

This complex is about 70 percent Chetek sandy loam and 30 percent Onamia sandy loam and loam. The Chetek soil is mainly near the crests of knolls. In most areas it is more eroded than the Onamia soils, which are near drainageways and on concave parts of knolls.

The Chetek soil has a profile similar to the one described as representative of the series, but the subsoil is thinner and contains less clay and more sand and gravel. The Onamia soils have a profile similar to the one described as representative of the series, but the surface layer and subsoil are thinner and contain more sand.

Included with these soils in mapping are wet soils in drainageways and depressions, and a few areas of soils that have a thin mantle of reddish colored silt loam, loam, or sandy loam glacial drift that is underlain by sand and gravel at a depth of 3 to 5 feet. Also included are a few small sandy and gravelly areas where the soil is severely eroded, and a few small areas

where slopes are less than 20 percent or more than 30 percent.

Runoff is very rapid, and the hazard of erosion is very severe.

Most areas of this complex are wooded or in pasture. These soils are suited to grasses for pasture. They are also suited to red and white pine. In many areas crop yields are limited by low available water capacity. Slopes facing south and southwest are more droughty and less suited to trees than slopes facing north and northeast. Controlling erosion is an important factor of good management. Capability unit VIIe–3; woodland group 3d2.

Clyde Series

The Clyde series consists of nearly level and gently sloping, poorly drained and very poorly drained soils in drainageways of low ground moraines. These soils formed in silty sediment and the underlying sticky, heavy loam till. Native vegetation was wetland prairie grasses, sedges, brush, and some trees, such as elm, ash, and tamarack. Water is at or near the surface throughout the year.

In a representative profile the surface layer is black silt loam about 18 inches thick (fig. 4). The subsoil is about 16 inches thick. In the upper part it is grayish brown and olive gray, friable, mottled, heavy silt loam; in the lower part it is gray, very sticky, heavy loam. The substratum, to a depth of 60 inches, is greenish gray, plastic, mottled, heavy loam.

Available water capacity is high, and permeability is moderately slow. Natural fertility and the organic matter content of the surface layer are high. Depth of the root zone is limited for most farm crops by a perched water table.

Most areas of these soils are in wetland pasture and woodland. Where drained, Clyde soils are used for corn and other row crops.

Representative profile of Clyde silt loam, 0 to 3 percent slopes, in an uncultivated area, 150 yards east and 70 yards south of northwest corner of sec. 32, T. 29 N., R. 16 W.:

A1—0 to 8 inches; black (10YR 2/1) silt loam; weak moderate medium subangular blocky structure; friable; many roots; mildly alkaline; abrupt smooth boundary.

A12—8 to 12 inches; black (10YR 2/1) silt loam; moderate medium and fine subangular blocky structure; friable; many roots; mildly alkaline; clear smooth boundary.

A3—12 to 18 inches; black (10YR 2/1) silt loam; common fine prominent mottles of reddish brown (5YR 4/4); moderate medium subangular blocky structure; friable, slightly sticky; few roots; thin clay films and organic coatings on faces of peds; mildly alkaline; clear wavy boundary.

B21g—18 to 23 inches; grayish brown (2.5Y 5/2) heavy silt loam; few fine prominent mottles of reddish brown (5YR 5/4); moderate medium subangular blocky structure; friable, slightly sticky; few roots; mildly alkaline; clear wavy boundary.

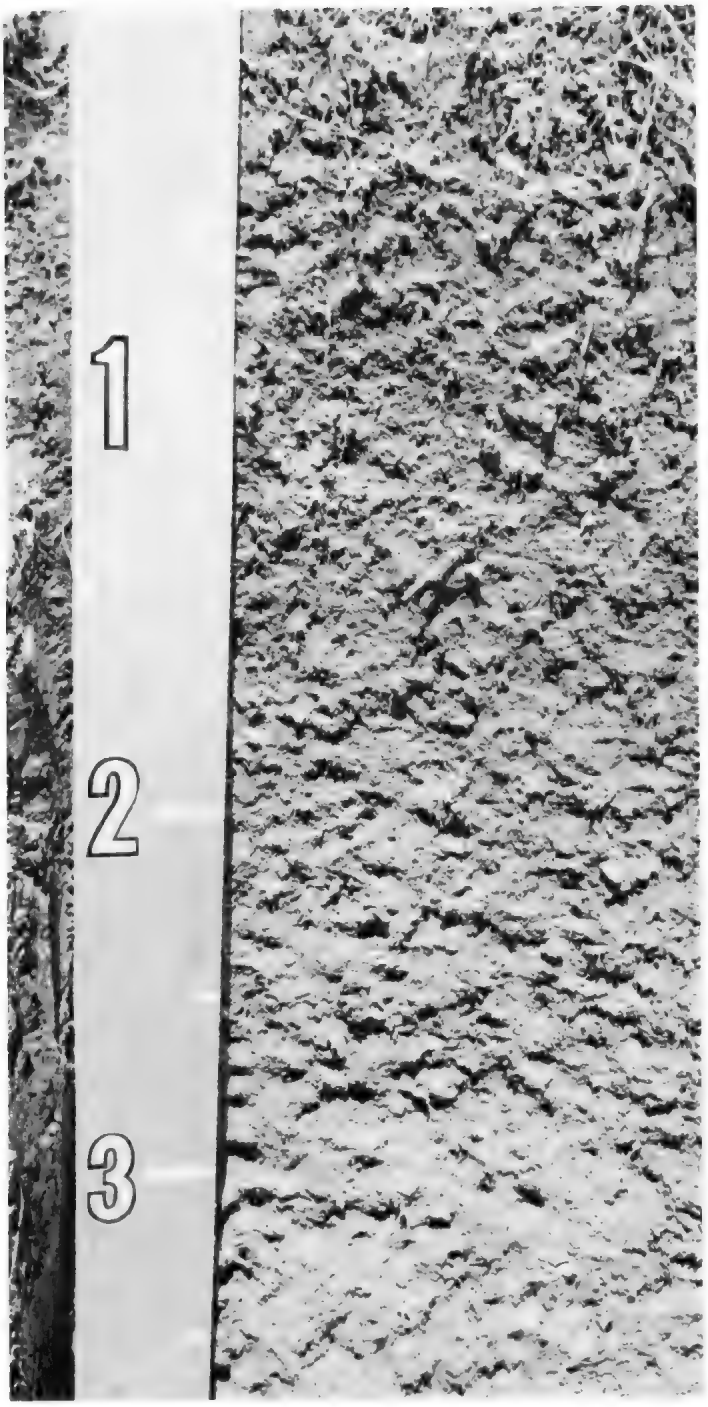


Figure 4.—**Profile of Clyde silt loam. This poorly drained and very poorly drained soil is underlain by heavy loam at a depth of about 3 feet.**

B22g—23 to 28 inches; olive gray (5Y 5/2) heavy silt loam; common medium distinct mottles of reddish brown (5YR 4/4); weak fine subangular blocky structure; slightly sticky; mildly alkaline; clear smooth boundary.

IIB23g—28 to 34 inches; gray (5Y 5/1) heavy

loam; weak medium prismatic structure that parts to weak medium and coarse subangular blocky; very sticky; band of pebbles and about 4 percent coarse fragments by volume; mildly alkaline; clear smooth boundary.

IICg—34 to 60 inches; greenish gray (5GY 6/1) heavy loam; common fine prominent mottles of strong brown (7.5YR 5/6); massive; plastic; about 5 percent coarse fragments by volume; contains loamy bands ranging from 1 to 6 inches in thickness; mildly alkaline.

The solum ranges from 30 to 40 inches in thickness. The silty sediment is 20 to 40 inches thick. The A1 horizon is black silt loam or silty clay loam 10 to 20 inches thick.

The lower part of the Bg horizon and the Cg horizon are heavy loam or clay loam. The lower part of the Bg horizon and the Cg horizon are 0 to 5 percent coarse fragments, and they contain thin, gravelly bands. The B and C horizons are mildly alkaline.

Clyde soils are near Floyd and Auburndale soils. They are poorly drained, and they lack the brown colors in the upper part of the B horizon typical of Floyd soils. Clyde soils have a thicker, darker colored A horizon and they contain more silt and clay than Auburndale soils.

CyA—Clyde silt loam, 0 to 3 percent slopes. This soil is in drainageways of low ground moraines. Most areas are elongated and range from 10 to 100 acres in size.

Included with this soil in mapping are a few small areas of Floyd and Rib soils, and Fluvaquents, wet. Also included are a few areas of Clyde soils that are underlain by sandstone residuum at a depth of more than 40 inches.

This soil is wet most of the year because of a seasonal high perched water table. Runoff is slow and ponded, and permeability is moderately slow, which makes drainage difficult. Shallow surface drains, tile drainage, and water diversions can be used to drain some areas and permit tillage. Frost late in spring and early in fall is common on this soil.

This soil is suited to wetland pasture and hardwoods. Where adequately drained, it is moderately well suited to row crops. Capability unit IIw–1; woodland group 4w2.

Cromwell Series

The Cromwell series consists of sloping to steep, somewhat excessively drained soils on moraines and areas of pitted glacial drift. These soils formed mainly in a reddish sandy loam and loamy sand glacial drift that is underlain by sand and gravel. Native vegetation varied but was mainly aspen, birch, and red oak.

In a representative profile the surface layer is about 8 inches of dark brown sandy loam. The subsoil is about 34 inches thick. The upper part is yellowish red, friable, heavy sandy loam, the middle part is yellowish red, very friable, heavy loamy sand, and the lower part is yellowish red, very friable, gravelly loamy sand. The substratum, to a depth of 60 inches, is strong brown, loose sand.

Available water capacity is low, and permeability is moderate in the loamy upper part of the profile and rapid in the sandy lower part. Natural fertility and the organic matter content of the surface layer are low.

Most areas of these soils are in hay or pasture.

In St. Croix County Cromwell soils are mapped only in complex with Amery soils.

Representative profile of Cromwell sandy loam, in an area of Amery–Cromwell sandy loams, 6 to 12 percent slopes, eroded, 110 yards south and 80 yards east of northwest corner of SW¼, sec. 9, T. 30 N., R. 19 W.:

Ap—0 to 8 inches; dark brown (10YR 3/3) sandy loam, brown (10YR 5/3) dry; coarse and medium subangular blocky structure; friable; many roots; slightly acid; abrupt smooth boundary.

Bt—8 to 15 inches; yellowish red (5YR 4/6) heavy sandy loam; moderate coarse subangular blocky structure; friable; thin patchy clay films; common roots; medium acid; clear wavy boundary.

B31—15 to 30 inches; yellowish red (5YR 4/6) heavy loamy sand; weak coarse and medium subangular blocky structure; very friable; some clay bridging between sand grains; common roots; about 15 percent coarse fragments by volume; medium acid; clear smooth boundary.

B32—30 to 42 inches; yellowish red (5YR 4/6) gravelly loamy sand; weak coarse and medium subangular blocky structure parting to single grained where disturbed; very friable; about 20 percent coarse fragments by volume; medium acid; clear smooth boundary.

IIC—42 to 60 inches; strong brown (7.5YR 5/6) sand; about 15 percent coarse fragments by volume; single grained; loose; medium acid.

The solum thickness and depth to sand and gravel range from 32 to 50 inches. The Ap horizon is very dark grayish brown, dark brown, or dark grayish brown fine sandy loam or sandy loam 5 to 10 inches thick.

The C horizon is sand or sand and gravel. The C horizon is 5 to 20 percent coarse fragments. The B and C horizons are medium acid to strongly acid.

Cromwell soils are near Amery and Santiago soils and Jewett, sandy substratum. Cromwell soils are underlain by sand and gravel rather than the sandy loam till typical of Amery soils and Santiago soils. They contain more sand and less silt and clay than Santiago soils. Cromwell soils have a lighter colored A horizon and less silt and clay than Jewett, sandy substratum, soils.

Cut and Fill Areas

Cz—Cut and fill areas consist of borrow pits that have been reclaimed by smoothing and seeding with grasses and legumes. These areas are mainly loamy glacial drift that is stony or gravelly in many places. Most areas are elongated or round and range from 10

to 80 acres in size. They are mainly well drained and moderately well drained but a few areas are excessively drained or somewhat poorly drained to very poorly drained. Slopes are 0 to 20 percent.

Included in mapping of cut and fill areas are a few sandy and clayey areas and small areas of undisturbed sandy and loamy soils.

Available water capacity is mainly moderate but is low or high in a few areas. Natural fertility is low or medium. The organic matter content of the surface layer is low. Cut and fill areas are 0 to 70 percent coarse fragments.

Most areas are in pasture and brush or have been planted to pine tree plantations. A few areas are used as building sites. Not assigned to a capability unit or woodland group.

Dakota Series

The Dakota series consists of nearly level to sloping, well drained soils on stream terraces, outwash plains and knolls of pitted outwash plains. These soils formed in loamy sediment underlain by sand and gravel. Native vegetation was prairie grasses.

In a representative profile the surface layer is about 14 inches of loam. It is very dark brown in the upper part and very dark grayish brown in the lower part. The subsoil is about 14 inches thick. It is dark brown, friable and very friable loam in the upper 11 inches and brown, very friable sandy loam in the lower 3 inches. The substratum, to a depth of about 60 inches, is brown sand and gravel.

Available water capacity is moderate, and permeability is moderate in the subsoil and rapid in the substratum. Natural fertility is medium. The organic matter content of the surface layer is high.

These soils are used to grow corn, soybeans, and such cash crops as sweet corn, peas, or beans.

Representative profile of Dakota loam, 0 to 2 percent slopes, in a cultivated field, 220 yards east and 350 yards north of southwest corner of sec. 16, T. 29 N., R. 19 W.:

Ap—0 to 6 inches; very dark brown (10YR 2/2) loam; weak fine granular structure; friable; common roots; strongly acid; abrupt smooth boundary.

A12—6 to 11 inches; very dark brown (10YR 2/2) loam; moderate coarse subangular blocky structure; friable; common roots; strongly acid; clear wavy boundary.

A3—11 to 14 inches; very dark grayish brown (10YR 3/2) loam; moderate coarse subangular blocky structure; friable; common roots; strongly acid; clear wavy boundary.

B21t—14 to 21 inches; dark brown (7.5YR 4/4) loam; moderate coarse subangular blocky structure; friable; thin patchy clay films; common roots; medium acid; clear wavy boundary.

B22t—21 to 25 inches; dark brown (7.5YR 4/4) loam; weak coarse and medium subangular blocky structure; very friable; thin patchy clay films; common roots; medium acid; clear wavy boundary.

B3—25 to 28 inches; brown (7.5YR 4/4) sandy loam; weak medium subangular blocky structure; very friable; few roots; slightly acid.

C—28 to 60 inches; brown (7.5YR 4/4) sand and gravel; single grained; loose; about 15 percent coarse fragments by volume; slightly acid.

The solum thickness and depth to sand and gravel range from 20 to 40 inches. The A horizon is black, very dark brown, very dark grayish brown, or dark reddish brown and 10 to 24 inches thick.

The B horizon is loam in the upper part and sandy loam in the lower part. The C horizon is sand or sand and gravel. It is 5 to 20 percent coarse fragments. The B and C horizons are slightly acid to strongly acid.

Dakota soils are associated with Burkhardt and Pillot soils. They lack the moderately deep silt mantle characteristic of Pillot soils. They contain more clay in the B horizon and are deeper to sand and gravel than Burkhardt soils.

DaA—Dakota loam, 0 to 2 percent slopes. This soil is on stream terraces and outwash plains. Most areas are irregular in shape and range from 10 to 30 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas where the surface layer is sandy loam.

Runoff is very slow, and the hazard of erosion is slight.

This soil is moderately well suited to corn and such special cash crops as beans and peas. Irrigation may be feasible on large areas of this soil where vegetables or other high value crops are grown. The main concerns of management are maintaining tilth and soil structure. Capability unit IIs–1; not assigned to a woodland group.

DaB—Dakota loam, 2 to 6 percent slopes. This soil is on stream terraces and outwash plains. Most areas are irregular in shape and range from 10 to 80 acres in size.

This soil has a profile similar to the one described as representative of the series, but the surface layer is thinner and lighter colored and the subsoil contains slightly more sand and less silt and clay.

Included with this soil in mapping are a few areas where the surface layer is sandy loam and a few small areas of Burkhardt and Sattre soils. Also included are a few small areas where slopes are less than 2 percent or more than 6 percent.

Runoff is slow, and the hazard of erosion is slight.

Most areas of this soil are moderately well suited to such row crops as corn, soybeans, beans, and peas. Irrigation may be feasible on large areas of this soil where vegetables or other high value crops are grown. Capability unit IIe–2; not assigned to a woodland group.

DcC2—Dakota-Pillot complex, 6 to 12 percent slopes, eroded. The soils in this complex are on stream terraces adjacent to the uplands and on pitted outwash plains.

This complex is about 45 percent Dakota loam, 30 percent Pillot silt loam, and 25 percent other soils, mainly Sattre and Burkhardt soils. The Dakota soil is near the crests of knolls or near the upper, more convex parts of slopes. In most areas the Dakota soil is slightly

more eroded than the Pillot soil, which is mainly on the concave parts of lower slopes, depressions, and drainageways.

The Dakota soil has a profile similar to the one described as representative of the series, but the surface layer is slightly thinner and lighter colored. The Pillot soil has a profile similar to the one described as representative of the series, but it contains slightly more sand and has a thicker surface layer. Most Sattre and Burkhardt soils are on eroded crests of knolls and convex parts of slopes.

Included with these soils in mapping are a few small areas of Chetek, Emmert, and Onamia soils. Also included are some small areas of Rockton soils and a few small areas where slopes are less than 6 percent or more than 12 percent.

Runoff is medium, and the hazard of erosion is moderate. In most places, erosion has caused the tilth to deteriorate and has reduced the content of organic matter in the surface layer.

Most areas of this complex are cultivated. These soils are suited to oats, alfalfa, and a limited amount of corn and soybeans. Controlling erosion and maintaining soil tilth are important factors of good management. Capability unit IIIe–2; not assigned to a woodland group.

Derinda Series

The Derinda series consists of gently sloping and sloping, moderately well drained soils of shale uplands. These soils formed in silty sediment and the underlying silty clay weathered from shale. Native vegetation was sugar maple, basswood, and elm. The subsoil of Derinda soils is saturated with water for periods long enough to adversely affect or delay tillage.

In a representative profile the surface layer is about 9 inches of very dark grayish brown silt loam. The subsurface layer is dark grayish brown silt loam about 2 inches thick. The subsoil is about 19 inches thick. In the upper part it is yellowish brown, friable, mottled silt loam, in the middle part it is dark brown, firm, mottled silty clay loam, and in the lower part it is olive gray, firm, mottled silty clay. The substratum, to a depth of about 60 inches, is olive clay shale interbedded with fragmented dolomitic limestone.

Available water capacity is moderate, and permeability is slow. Natural fertility is medium. The organic matter content of the surface layer is moderate. Water is ponded in spring and after heavy rain. Depth of the root zone is limited for most farm crops by the firm, silty clay subsoil.

Most areas of these soils are cultivated. The soils are used for corn, oats, and grasses. A few areas are in pasture and woods.

Representative profile of Derinda silt loam, 2 to 6 percent slopes, in a cultivated field, 175 yards south and 220 yards east of northeast corner of the SE¼ of sec. 12, T. 28 N., R. 19 W.:

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam; moderate coarse subangular blocky structure; friable; slightly acid; abrupt smooth boundary.

A2—9 to 11 inches; dark grayish brown (10YR 4/2) silt loam; weak coarse subangular blocky structure that parts to weak medium plates; friable; medium acid; abrupt wavy boundary.

B1—11 to 17 inches; yellowish brown (10YR 5/4) silt loam; common fine distinct strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; friable; few thin patchy clay films on vertical faces of peds; friable; medium acid; clear wavy boundary.

B21t—17 to 20 inches; yellowish brown (10YR 5/4) heavy silt loam; common fine distinct strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; friable; thin patchy clay films on faces of peds; medium acid; clear wavy boundary.

B22t—20 to 26 inches; dark brown (10YR 4/3) silty clay loam; common fine distinct strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; firm; thin patchy clay films on faces of peds; medium acid; abrupt wavy boundary.

IIB23t—26 to 30 inches; olive gray (5Y 4/2) silty clay; common medium prominent olive yellow (5Y 6/6) mottles; moderate coarse prismatic structure parting to strong coarse subangular blocky structure; firm; thin continuous clay films on faces of peds; neutral; gradual wavy boundary.

Cr—30 to 60 inches; olive (5Y 5/3) clay shale interbedded with fragmented dolomitic limestone; common medium prominent olive yellow (5Y 6/6) mottles; massive; moderately alkaline.

The solum thickness and depth to shale bedrock range from 20 to 40 inches. Thickness of the silt mantle ranges from 15 to 30 inches. The A1 horizon is black or very dark brown and 3 to 6 inches thick. The Ap horizon is dark grayish brown or very dark grayish brown and 6 to 10 inches thick.

The C horizon is shale or shale interbedded with fragmented limestone. Fragmented limestone is below a depth of 4 to 6 feet. The B horizon is medium acid to neutral, and the C horizon is mildly alkaline to strongly alkaline.

Derinda soils are near Derinda Variant and Vlasaty soils. They are better drained than Derinda Variant soils. The lower part of their B horizon formed in silty clay shale residuum, whereas that of Vlasaty soils typically formed in heavy loam and clay loam till.

DeB—Derinda silt loam, 2 to 6 percent slopes. This soil is on ridgetops of shale uplands. Most areas are oblong or irregular in shape and range from 5 to 80 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas where the silty mantle is less than 10 inches thick and some small areas where it is 30 to 40 inches thick. Also included are small areas of Derinda Variant soils, and areas of soils that have loamy bands of glacial drift in the subsoil.

Runoff is slow, and the hazard of erosion is slight. Water is ponded in slightly concave areas in spring and after heavy rains. Also, the subsoil is saturated

with water for periods long enough to adversely affect or delay tillage. Maintaining soil tilth and soil structure is difficult.

Most areas of this soil are cultivated. The soil is moderately well suited to corn, oats, and grasses. Depth of the rooting zone is limited for most farm crops by a firm, silty clay subsoil. Controlling erosion and maintaining soil structure are important factors of good management. Capability unit IIe–6; woodland group 2o1.

DeC2—Derinda silt loam, 6 to 12 percent slopes, eroded. This soil is on areas that are peripheral to the ridgetops of the shale uplands. Most areas are long and narrow in shape and range from 5 to 15 acres in size.

This soil has a profile similar to the one described as representative of the series, but the silty mantle and surface layer are thinner and the surface layer contains more clay and is less friable.

Included with this soil in mapping are small areas where the silty mantle is less than 10 inches thick and a few areas where it is 30 to 40 inches thick. Also included are areas where layers of loamy drift are in the subsoil and a few small areas where slopes are less than 6 percent or more than 12 percent.

Runoff is medium, and the hazard of erosion is moderate. Erosion has caused tilth to deteriorate and has reduced the content of organic matter in the surface layer.

Most areas of this soil are cultivated. The soil is well suited to oats, alfalfa, grasses, and a limited amount of corn and other row crops. Depth of the rooting zone is limited for most farm crops by a firm silty clay subsoil. Controlling erosion and maintaining soil tilth and organic matter content are important factors of good management. Capability unit IIIe–6; woodland group 2o1.

Derinda Variant

The Derinda Variant consists of nearly level and gently sloping, somewhat poorly drained soils of the shale uplands. These soils formed mainly in silty sediment and the underlying silty clay weathered from shale. Native vegetation was wetland prairie grasses, brush, and such trees as elm and ash. Unless these soils are drained, the subsoil is saturated with water throughout most of the year.

In a representative profile the surface layer is about 9 inches of very dark gray silt loam. The subsurface layer is about 5 inches of dark grayish brown mottled silt loam. The subsoil is about 16 inches thick. In the upper part it is brown, firm, mottled silt loam, and in the lower part it is mainly olive and olive gray, very firm, mottled silty clay. The substratum, to a depth of about 40 inches, is olive gray and pale green, extremely firm, mottled silty clay. Below this, to a depth of 60 inches, it is olive gray and pale green clay shale. There are limestone fragments in the shale.

Available water capacity is moderate, and permeability is slow. Natural fertility is medium. The organic matter content of the surface layer is high. Depth of the root zone is limited for most farm crops by a perched water table and by the very firm subsoil. The shrink-swell potential of the silty clay subsoil and substratum is high.

Most areas of these soils are cultivated. Where excess water is removed, the soils are moderately well suited to row crops. Most small areas along drainageways are in wetland pasture, brush, and a few trees.

Representative profile of Derinda Variant silt loam, 1 to 6 percent slopes, in a cultivated area, 330 yards west and 30 yards south of northeast corner of SE¼, sec. 34, T. 28 N., R. 18 W.:

Ap—0 to 9 inches; very dark gray (10YR 3/1) silt loam; moderate fine and medium subangular blocky structure parting to moderate medium granular; friable; common roots; slightly acid; abrupt smooth boundary.

A2—9 to 14 inches; dark grayish brown (10YR 4/2) silt loam; common fine prominent yellowish brown (10YR 5/6) and dark yellowish brown (10YR 4/4) mottles; moderate thin and medium platy structure; firm; common roots; medium acid; clear wavy boundary.

B1—14 to 18 inches; brown (10YR 4/3) silt loam; common fine prominent yellowish red (5YR 4/6) mottles; moderate fine and medium subangular blocky structure; firm; few roots; medium acid; clear wavy boundary.

IIB2t—18 to 25 inches; olive (5Y 5/3) silty clay; many medium prominent yellowish brown (10YR 5/6) and many medium faint olive gray (10YR 5/2) mottles; strong medium subangular blocky structure; very firm; few roots; very dark gray (10YR 3/1) clay coatings on ped faces; medium acid; clear wavy boundary.

IIB3t—25 to 30 inches; olive gray (5Y 5/2) silty clay; many medium prominent yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; very firm; few roots; very dark gray (10YR 3/1) clay coatings on ped faces; slightly acid; clear wavy boundary.

IIC1—30 to 40 inches; olive gray (5Y 5/2) and pale green (5G 6/2) silty clay weathered from shale; medium fine prominent light olive brown (2.5Y 5/6) mottles; massive; extremely firm; neutral; clear wavy boundary.

Cr—40 to 60 inches; olive gray (5Y 5/2) and pale green (5G 6/2) clay shale with fragmented limestone; massive; extremely firm; mildly alkaline.

The solum thickness and depth to shale bedrock range from 20 to 40 inches. The silty mantle is 15 to 30 inches thick. The Ap horizon is very dark grayish brown, very dark brown, or very dark gray and 6 to 10 inches thick.

In places loamy bands of glacial drift 2 to 6 inches thick overlie the silty clay part of the B horizon. The C horizon is clay shale and silty clay residuum weathered from shale.

Derinda Variant soils are near Derinda soils. They are more poorly drained than Derinda soils.

DfB—Derinda Variant silt loam, 1 to 6 percent

slopes. This soil is on ridges and drainageways of shale uplands.

Included with this soil in mapping are many small areas of soils along drainageways where the surface layer is thicker and darker colored than that of the Derinda Variant soil, a few areas of poorly drained soils, and a few areas where the silty mantle is more than 30 inches thick. Also included are a few areas of Derinda soils, a few areas underlain by limestone bedrock at a depth of 3 to 5 feet, and a few areas where slopes are less than 1 percent or more than 6 percent.

Runoff is slow, and the hazard of erosion is slight. This soil has a seasonal high, perched water table at a depth of 1 to 3 feet. Also, in places the soil is ponded or flooded. Surface drains and water diversions help remove excess water and improve crop growth. The silty clay subsoil and substratum have a high shrink-swell potential.

Most areas of this soil are cultivated. Where excess water is removed, the soil is moderately well suited to corn and other row crops. Capability unit IIw–3; woodland group 3o2.

Dickman Series

The Dickman series consists of gently sloping, somewhat excessively drained soils on sandy outwash plains or stream terraces. These soils formed in sandy loam and loamy sand sediment underlain by loose sand and gravel. Native vegetation was mainly prairie grasses and oak savanna.

In a representative profile the surface layer is about 11 inches of very dark grayish brown sandy loam. The subsoil is about 21 inches thick. It is dark brown, very friable sandy loam in the upper part and dark brown, very friable loamy sand in the lower part. The substratum, to a depth of about 60 inches, is dark brown sand and gravel.

Available water capacity is low, and permeability is moderately rapid to a depth of about 18 inches and rapid below. Natural fertility is low. The organic matter of the surface layer is moderately low. Soil blowing is a moderate hazard.

These soils are used for corn, oats, or alfalfa. Some peas and beans are also grown. Where irrigated, these soils are well suited to potatoes and other special vegetable crops.

Representative profile of Dickman sandy loam, 2 to 6 percent slopes, in cultivated area, 220 yards south and 220 yards east of northwest corner of NE¼ sec. 29, T. 28 N., R. 18 W.:

Ap—0 to 11 inches; very dark grayish brown (10YR 3/2) sandy loam; weak fine and medium granular structure; very friable; common roots; medium acid; abrupt smooth boundary.

B2—11 to 18 inches; dark brown (10YR 4/3) sandy loam; moderate; medium subangular blocky structure; very friable; common roots; medium acid; clear smooth boundary.

B3—18 to 21 inches; dark brown (7.5YR 4/4) loamy sand; moderate medium blocky structure; very friable; few roots; medium acid; gradual wavy boundary.

B32—21 to 32 inches; dark brown (7.5YR 4/4) loamy sand; weak medium subangular blocky structure; very friable; few roots; medium acid; abrupt smooth boundary.

C—32 to 60 inches; dark brown (7.5YR 4/4) sand and gravel; single grained; loose; about 10 percent gravel by volume; slightly acid.

The solum ranges from 20 to 40 inches in thickness. The Ap horizon is dark reddish brown, dark brown, very dark brown, or very dark grayish brown and 10 to 24 inches thick.

The B horizon is medium acid to strongly acid, and the C horizon is medium acid to slightly acid. The C horizon is 0 to 20 percent gravel.

Dickman soils in St. Croix County are redder in the B and C horizons, contain more silt in the solum, and have coarser sand and more gravel in the C horizon than is defined as the range for the series, but these differences do not alter their usefulness or behavior.

Dickman soils are near Dakota and Hubbard soils. They contain slightly more silt and clay than Hubbard soils. They contain more sand and less silt and clay than Dakota soils.

DkB—Dickman sandy loam, 2 to 6 percent slopes. This soil is on stream terraces. Most areas are oblong or elongated and range from 5 to 40 acres in size.

Included with this soil in mapping are a few small areas of Chetek, Dakota, and Hubbard soils. Also included are a few small areas where the surface layer is loamy sand.

Runoff is slow, and the hazard of erosion is slight. Soil blowing is a moderate hazard.

Most areas of this soil are suited to corn, oats, or alfalfa. Crop yields are generally limited by low available water capacity. Irrigation is feasible in some areas of this soil where vegetables or other high value crops are grown. Capability unit IIIe–3; woodland group 3o1.

Duelm Series

The Duelm series consists of nearly level, somewhat poorly drained soils on stream terraces. These sandy soils are underlain by sand and gravel. Native vegetation was mainly prairie grasses. Unless these soils are drained, the substratum is saturated by ground water throughout most of the year.

In a representative profile the surface layer is black loamy sand about 17 inches thick. The substratum, to a depth of about 60 inches, is grayish brown, mottled, medium and coarse sand.

Available water capacity is low, and permeability is rapid. Natural fertility is low. The organic matter content of the surface layer is moderately low. Depth of the root zone is limited for most farm crops by the seasonal high water table.

Most areas of these soils are used for pasture. A few areas are cultivated.

Representative profile of Duelm loamy sand, in a cultivated area, in center of the NE¼, sec. 2, T. 30 N., R. 19 W.:

Ap—0 to 8 inches; black (10YR 2/1) loamy sand; weak medium and fine granular structure; very friable; many roots; strongly acid; abrupt smooth boundary.

A12—8 to 14 inches; black (10YR 2/1) loamy sand; moderate coarse subangular blocky structure; very friable; many roots; medium acid; abrupt smooth boundary.

AC—14 to 17 inches; black (10YR 2/1) and brown (10YR 5/3) loamy sand; very weak medium subangular blocky structure; very friable; many roots; medium acid; clear wavy boundary.

C—17 to 60 inches; grayish brown (10YR 5/2) medium and coarse sand; common coarse prominent brownish yellow (10YR 6/6 and 6/8) mottles; loose; single grained; neutral.

The A horizon is black, very dark brown, or very dark grayish brown and is 10 to 20 inches thick. The surface layer and substratum are slightly acid to neutral.

Duelm soils are near Plainfield and Hubbard soils and Fluvaquents, wet. They are better drained than Fluvaquents, wet. They are more poorly drained than Plainfield and Hubbard soils. Duelm soils have a thicker, darker colored surface layer than Plainfield soils.

Du—Duelm loamy sand. This soil is in drainageways of stream terraces. Most areas are elongated or oblong and range from 5 to 30 acres in size. Slopes are 0 to 2 percent.

Included with this soil in mapping are a few small areas of Fluvaquents, wet, and Udifluvents. Also included are a few small areas where the surface layer is more than 24 inches thick and a few small areas where the surface layer is sandy loam or loam.

This soil has a seasonal high water table throughout most of the year at a depth of 1 to 3 feet. Runoff is very slow. This soil is ponded or flooded during wet seasons. In drained areas, soil blowing is a hazard. Crop yields are generally limited by low available water capacity. Surface drainage helps remove runoff water. Ditches help lower the water table.

Most areas of this soil are used for pasture. The main concerns of management are removing excess water and controlling soil blowing in drained areas. Capability unit IVw–5; woodland group 3s2.

Emmert Series

The Emmert series consists of moderately steep to very steep, excessively drained soils on pitted outwash plains and eskers. These sandy soils are underlain by sand and gravel. Native vegetation was mainly oak savanna.

In a representative profile the surface layer is about 8 inches of very dark brown loamy sand. The next layer is dark reddish brown gravelly sand about 7 inches thick. The substratum, to a depth of about 60 inches, is strong brown sand and gravel.

Available water capacity is very low, and permeability is very rapid. Natural fertility is low. The organic matter content of the surface layer is moderately low.

Most areas of these soils are in pasture or woodland. These soils are a good source of sand and gravel.

Representative profile of Emmert loamy sand, 12 to 35 percent slopes, in a cultivated area, 400 yards west and 200 yards north of southeast corner of the NE¼, sec. 13, T. 29 N., R. 19 W.:

Ap—0 to 8 inches; very dark brown (10YR 2/2) loamy sand; weak fine granular structure; very friable; slightly acid; abrupt smooth boundary.

AC—8 to 15 inches; dark reddish brown (5YR 3/3) gravelly sand; very weak medium subangular blocky structure that parts to single grained where disturbed; loose; about 20 percent coarse fragments by volume; slightly acid; clear smooth boundary.

C—15 to 60 inches; strong brown (7.5YR 5/6) sand and gravel; about 35 percent coarse fragments by volume; loose; slightly acid.

The solum ranges from 12 to 24 inches in thickness. The A horizon is black or very dark brown loamy sand or sandy loam 3 to 10 inches thick.

The C horizon is 30 to 45 percent coarse fragments. The A and C horizons are strongly acid to neutral.

Emmert soils are near Burkhardt and Sattre soils. They lack the sandy loam B horizon typical of Burkhardt soils. They lack the silt loam or loam A horizon and the loam B horizon typical of Sattre soils.

EmE—Emmert loamy sand, 12 to 35 percent slopes. This soil is on pitted outwash plans and eskers. Most areas are elongated or irregular in shape and range from 5 to 60 acres in size.

Included with this soil in mapping are a few areas of Burkhardt and Sattre soils along foot slopes and in drainageways. Also included are a few areas where the soil is gravelly and severely eroded, and a few, small areas where slopes are less than 12 percent.

Runoff is medium or rapid, and the hazard of erosion is severe.

This soil is not suited to cultivated crops. It is used for woodland, wildlife, and such recreational uses as hunting, tobogganing, hiking, bridle trails, and snowmobiling. Many areas of this soil are good sources of sand and gravel. Controlling erosion is an important factor of good management. Capability unit VIIs–5; woodland group 4f2.

Floyd Series

The Floyd series consists of nearly level and gently sloping, somewhat poorly drained soils on foot slopes and in drainageways of low ground moraines. These soils formed in silt loam sediment and the underlying heavy loam and clay loam till. Native vegetation was wetland prairie grasses, brush, and some trees, such as elm and ash. Unless these soils are drained, the subsoil is saturated with water throughout most of the year.

In a representative profile the surface layer is about 14 inches of black silt loam. The subsoil is about 28 inches thick. In the upper part it is brown and yellowish brown, friable, heavy silt loam; in the middle part it is yellowish brown, firm, mottled loam; and in the lower part it is grayish brown and gray, firm, mottled, heavy loam. The substratum, to a depth of about 60 inches, is olive gray, mottled, heavy loam.

Available water capacity is high, and permeability is moderately slow. Natural fertility and the organic matter content of the surface layer are high. Depth of the root zone is somewhat limited for most farm crops by a seasonal perched water table in the subsoil.

Most areas of these soils are cultivated. A few areas are in wetland pasture or trees.

Representative profile of Floyd silt loam, 0 to 3 percent slopes, in a cultivated field, 200 yards south and 200 yards east of northwest corner of the SE¼ of sec. 24, T. 28 N., R. 17 W.:

Ap—0 to 6 inches; black (N 2/0) silt loam; moderate medium subangular blocky structure parting to weak thin plates; friable; many roots; neutral; abrupt smooth boundary.

A12—6 to 10 inches black (N 2/0) silt loam; strong medium subangular blocky structure; friable; many roots; neutral; clear wavy boundary.

A13—10 to 14 inches; black (N 2/0) heavy silt loam; weak and moderate medium granular structure; friable; many roots; neutral; clear wavy boundary.

B1—14 to 23 inches; brown and yellowish brown (10YR 4/3 and 5/6) heavy silt loam; moderate medium subangular blocky structure; friable; common roots; neutral; clear wavy boundary.

IIB21t—23 to 27 inches; yellowish brown (10YR 5/4) loam; many fine and medium distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; thick continuous clay films on surface of peds; few roots; common pebbles and cobblestones; neutral; clear wavy boundary.

IIB22tg—27 to 32 inches; grayish brown (10YR 5/2) heavy loam; many medium prominent yellowish brown (10YR 5/6) mottles; strong medium subangular blocky structure; firm; thick continuous clay films on surface of peds; few roots; common pebbles and cobblestones; neutral; clear wavy boundary.

IIB3tg—32 to 42 inches; gray (5Y 5/1) heavy loam; many medium prominent yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; thick continuous clay films on faces of peds; common pebbles and cobblestones; neutral; clear wavy boundary.

IICg—42 to 60 inches; olive gray (5Y 5/2) heavy loam; many medium prominent yellowish brown (10YR 5/6) mottles; massive; firm; common pebbles and cobblestones; moderately alkaline.

The solum ranges from 40 to 50 inches in thickness. The silt loam sediment is 20 to 30 inches thick. The A horizon is black or very dark brown and 10 to 20 inches thick.

The lower part of the B horizon is heavy loam or clay loam. The lower part of the B horizon and the C horizon are 0 to 5 percent coarse fragments.

Floyd soils are near Clyde and Skyberg soils. They are better drained than Clyde soils. They have a thicker, darker colored A horizon than Skyberg soils.

FdA—Floyd silt loam, 0 to 3 percent slopes. This soil is on foot slopes and in drainageways of ground moraines. Most areas are oblong and range from 5 to 60 acres in size.

Included with this soil in mapping are a few areas where gravelly bands are in the subsoil and substratum and a few areas consisting of deep silty alluvium. Also included are small areas of Clyde and Skyberg soils.

This soil has a seasonal high, perched water table at a depth of 1 to 3 feet. Runoff is slow. This soil is ponded or flooded, especially early in spring. Surface drains, water diversions and tile drainage help remove excess water and benefit plant growth. Frost late in spring and early in fall is common on this soil.

Most areas of this soil are used for corn. Where excess water is removed, the soil is well suited to most crops. Capability unit IIw–2; woodland group 4o1.

Fluvaquents

Fe—Fluvaquents consist of nearly level, somewhat poorly drained soils that are on flood plains of rivers and streams. Most areas are elongated in shape and range from 5 to 120 acres in size. Slopes are 0 to 2 percent. These soils formed in light and dark colored loamy sediment deposited by flood waters. The sediment ranges from sandy loam to silty clay loam, but in most places it is stratified silt and fine sand underlain by loose sand at a depth of 3 to 5 feet. This sediment has been deposited too recently for distinct horizons to form. Native vegetation was mostly wetland grasses and sedges and some trees such as willows and elms. These soils have a seasonal high water table at a depth of 1 to 3 feet.

Included with these soils in mapping are small areas of Duelm, Halder, Orion, Rib and Seelyeville soils, and Fluvaquents, wet; Saprists and Aquents; and Udifluvents.

Runoff is slow, and the hazard of erosion is slight. The available water capacity ranges from moderate to high. Natural fertility ranges from medium to high. The organic matter content of the surface layer is moderate. Most areas of these soils are flooded frequently for brief periods, especially in spring. Some places are dissected by streams, sloughs, and old stream channels. Streambank erosion is a hazard in some places.

Most areas of these soils are in pasture, trees, and brush. A few areas are in crops. If excess water is removed and the soils are protected from flooding, most areas of Fluvaquents are suited to crops. Capability unit IIw–13; woodland group 3o2.

Fluvaquents, Wet

Fm—Fluvaquents, wet consist of nearly level, poorly drained, and very poorly drained soils that are on flood plains of rivers and streams. Most areas are elongated in shape and range from 5 to 120 acres in size. Slopes are 0 to 2 percent. These soils formed in dark colored sediment deposited by floodwaters. The sediment ranges from sand to silty clay. In most places this sediment is underlain by loose sand at a depth of 3 to 5 feet. The sediment has been deposited too recently for distinct horizons to form. Native vegetation was mostly wetland grasses and sedges, some shrubs such as alder and willow, and a few scattered trees, such as elm and

black ash. These soils have a seasonal high water table at a depth of 0 to 1 foot.

Included with these soils in mapping are small areas of Duelm, Halder, Orion, Rib, and Seelyeville soils and Fluvaquents and Saprists and Aquents.

Runoff is slow, and the hazard of erosion is slight. Available water capacity, permeability, and natural fertility are too variable to rate. The organic matter content of the surface layer is moderate. Most areas are flooded frequently, especially in spring. Fresh alluvial sediment is deposited during each flood. Some places are dissected by the streams, sloughs, and old stream channels. Streambank erosion is a hazard in some places.

Most areas of these soils are in trees, brush, and marsh vegetation, and they are used for wildlife habitat. Where flooding is less frequent, a few small areas are pastured or cultivated. Capability unit Vw–14; woodland group 4w2.

Freeon Series

The Freeon series consists of gently sloping and sloping, moderately well drained soils. These soils are on low ridges and foot slopes of ground moraines. They formed in silty sediment and the underlying reddish sandy loam till. Native vegetation was mainly white pine, hard maple, and red oak. The lower part of the subsoil is saturated with water for long periods during the year.

In a representative profile the surface layer is about 8 inches of very dark grayish brown silt loam. The subsurface layer is brown silt loam about 10 inches thick. The subsoil is about 16 inches thick. The upper part is dark brown, mottled, friable silt loam; the middle part is reddish brown, mottled, friable to firm loam; and the lower part is reddish brown, mottled, firm loam. The substratum, to a depth of 60 inches, is yellowish red, mottled, firm sandy loam.

Available water capacity is high, and permeability is moderate. Natural fertility is medium. Tillage is delayed for relatively long periods in spring and after heavy rain.

Most areas of these soils are in corn, oats, and grasses.

Representative profile of Freeon silt loam, 2 to 6 percent slopes, in a cultivated area, 220 yards east and 100 yards south of northwest corner of SW¼, sec. 32, T. 30 N., R. 16 W.:

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, light brownish gray (10YR 6/2) dry; moderate medium subangular blocky structure; friable; common roots; slightly acid; clear smooth boundary.

A2—8 to 11 inches; brown (10YR 5/3) silt loam; moderate medium and thick platy structure; very friable; common roots; slightly acid; clear wavy boundary.

A&B—11 to 18 inches; brown (10YR 5/3) tongues of silt loam (A2); moderate medium platy structure; dark brown (10YR 4/3); slightly heavier silt loam (B21t); moderate medium subangular blocky structure; friable; common roots; slightly acid; clear wavy boundary.

IIB21t—18 to 23 inches; dark brown (7.5YR 4/4) loam; common fine and medium distinct strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; friable; common roots; uncoated silt and fine sand grains on faces of peds; few thin patchy clay films; common roots; about 15 percent coarse fragments by volume; strongly acid; clear wavy boundary.

IIB22t—23 to 29 inches; reddish brown (5YR 4/4) loam; common medium distinct strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; firm; clean silt and fine sand coatings on faces of peds; few thin patchy clay films; few roots; about 15 percent coarse fragments by volume; few black (10YR 2/1) concretions; strongly acid; clear wavy boundary.

IIB3—29 to 34 inches; reddish brown (5YR 4/4) loam; common fine distinct strong brown (7.5YR 5/6) mottles and few fine prominent grayish brown (10YR 5/2) mottles; weak coarse subangular blocky structure; firm; clean silt and fine sand coatings on faces of peds; few thin patchy clay films; about 15 percent coarse fragments by volume; few black (10YR 2/1) concretions; strongly acid; gradual wavy boundary.

IIC—34 to 60 inches; yellowish red (5YR 4/6) sandy loam; common fine and medium distinct brown (10YR 5/3) and common medium prominent grayish brown (10YR 5/2) mottles; massive; firm; about 15 percent coarse fragments by volume; strongly acid.

The solum ranges from 24 to 40 inches in thickness. The silty mantle is 15 to 30 inches thick. The Ap horizon is dark grayish brown or very dark grayish brown and 6 to 9 inches thick.

The Bt horizon is loam or heavy sandy loam in the lower part. The IIC horizon is a sandy loam or light loam. The IIB and IIC horizons are 5 to 15 percent coarse fragments. The subsoil is strongly acid, and the substratum ranges from strongly acid to slightly acid.

Freeon soils are near Magnor and Santiago soils. Freeon soils are not so well drained as Santiago soils and have mottling in the B horizon which Santiago soils lack. Freeon soils lack gray mottles in the upper part of the Bt horizon which are characteristic of Magnor soils and are better drained than Magnor soils.

FnB—Freeon silt loam, 2 to 6 percent slopes. This soil is on low ridges and foot slopes of ridges. Most areas are oblong and range from 10 to 80 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are a few areas of Magnor and Santiago soils. Also included are a few areas of sandy loam and a few areas where slopes are slightly less than 2 percent or more than 6 percent.

Runoff is slow, and the hazard of erosion is slight. Tillage is delayed because this soil remains saturated

for relatively long periods in spring and after heavy rains.

This soil is well suited to corn, oats, and alfalfa. It is frequently used for corn. Controlling erosion is an important factor of good management. Capability unit IIe–1; woodland group 1o1.

FoB—Freeon silt loam, heavy substratum, 2 to 6 percent slopes. This soil is on low ridges of ground moraines. Most areas are oblong and range from 5 to 40 acres in size.

This soil has a profile similar to the one described as representative of the series, but the substratum contains more silt and clay and the subsoil and substratum are saturated with water for longer periods.

Included with this soil in mapping are a few areas where the soil is underlain by shale residuum. Also included are small areas of Arland, Renova, Santiago, Skyberg, and Vlasaty soils.

Runoff is slow, and the hazard of erosion is slight. Available water capacity is very high. Permeability ranges from moderate in the subsoil to moderately slow in the substratum. The lower part of the subsoil is saturated with water for long periods throughout the year. Seasonal wetness delays tillage and plant growth.

Most areas of this soil are cultivated. A few areas are in woods. The soil is well suited to corn, oats, clover, and grasses. Controlling erosion is an important factor of good management. Capability unit IIe–1; woodland group 1o1.

FoC2—Freeon silt loam, heavy substratum, 6 to 12 percent slopes, eroded. This soil is on low ridges of ground moraines. Most areas are elongated or oblong and range from 5 to 20 acres in size.

This soil has a profile similar to the one described as representative of the series, but the surface layer is lighter colored and the substratum contains more silt and clay; also, the subsoil and substratum are saturated with water for longer periods.

Included with this soil in mapping are a few areas where the soil is underlain by shale residuum. Also included are a few areas of Arland, Renova, Santiago, Skyberg, and Vlasaty soils and a few areas where slopes are less than 6 percent or more than 12 percent.

Runoff is medium, and the hazard of erosion is moderate. Available water capacity is very high. Permeability ranges from moderate in the subsoil to moderately slow in the substratum. The lower part of the subsoil is saturated with water for long periods throughout the year. Seasonal wet conditions delay tillage and plant growth. In many areas, erosion has caused the tilth to deteriorate and has reduced the content of organic matter in the surface layer.

Most areas of this soil are cultivated. A few areas are in woods. The soil is suited to oats, alfalfa, and a limited amount of corn and other row crops. Controlling erosion and maintaining tilth and organic matter content are important factors of good management. Capability unit IIIe–1; woodland group 1o1.

Gotham Series

The Gotham series consists of gently sloping and sloping, somewhat excessively drained soils on stream terraces, outwash plains, and areas of pitted outwash plains. These are sandy soils underlain by loose, fine sand. Native vegetation was oak savanna.

In a representative profile the surface layer is very dark grayish brown loamy fine sand about 6 inches thick. The subsoil is about 24 inches thick. It is dark brown, dark yellowish brown, and brown, very friable loamy fine sand. The substratum, to a depth of about 60 inches, is brown fine sand that has bands of dark reddish brown fine sandy loam.

Available water capacity is low, and permeability is rapid. Natural fertility and the organic matter content of the surface layer are low.

Most areas of these soils are in pasture. Some of the gently sloping soils are used for corn, soybeans, and garden vegetables. Where irrigated and fertilized, these soils are well suited to potatoes and other special vegetable crops.

Representative profile of Gotham loamy fine sand, 2 to 6 percent slopes, in a cultivated area, 370 yards north and 200 yards west of southeast corner of sec. 13, T. 28 N., R. 20 W.:

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) loamy fine sand; brown (10YR 5/3) dry; weak fine subangular blocky structure; very friable; common roots; strongly acid; abrupt smooth boundary.

B1—6 to 13 inches; dark brown (10YR 3/3) loamy fine sand; pale brown (10YR 6/3) dry; weak medium subangular blocky structure; very friable; common roots; strongly acid; abrupt smooth boundary.

B12—13 to 24 inches; dark yellowish brown (10YR 4/4) loamy fine sand; weak medium subangular blocky structure; very friable; common roots; medium acid; abrupt smooth boundary.

B2t—24 to 30 inches; brown (7.5YR 4/4) loamy fine sand; moderate medium subangular blocky structure; very friable; clay bridging between sand grains and in pores; common roots; strongly acid; abrupt smooth boundary.

C—30 to 60 inches; brown (7.5YR 4/4) fine sand containing bands of dark reddish brown (5YR 3/4) fine sandy loam; single grained; loose; medium acid.

The solum ranges from 24 to 40 inches in thickness. The A horizon is very dark brown or very dark grayish brown loamy fine sand or loamy sand 6 to 15 inches thick.

The Bt horizon is loamy fine sand or light sandy loam. The C horizon consists of fine sand that has bands of sandy loam or heavy loamy fine sand. The B horizon is strongly acid or medium acid, and the C horizon is medium acid to slightly acid.

Gotham soils are associated with Dickman and Plainfield soils. Gotham soils have slightly more clay and silt in the B horizon and they have a darker colored A horizon than Plainfield soils. They contain slightly less silt and clay in the upper part of the solum than Dickman soils.

GoB—Gotham loamy fine sand, 2 to 6 percent slopes. This soil is on stream terraces and outwash plains. Most areas are irregular in shape and range from 10 to 40

acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of wet sandy soils in depressional areas where the surface layer is thicker and darker than the one in this Gotham soil. Also included are a few small areas of Plainfield and Sattre soils.

Runoff is very slow, and the hazard of erosion is slight. Soil blowing is a hazard.

Most areas of this soil are in pasture. Some areas are in pine plantations. Crop yields are generally limited by low available water capacity. If irrigated, large areas of this soil are suited for growing vegetables or other high value crops. Controlling soil blowing is an important factor of good management. Capability unit IVs–3; woodland group 3s1.

GoC—Gotham loamy fine sand, 6 to 12 percent slopes. This soil is on stream terraces and areas of pitted outwash plains. Most areas are elongated or irregular in shape and range from 10 to 20 acres in size.

This soil has a profile similar to one described as representative of the series, but the surface layer is thinner and lighter colored and the subsoil is thinner.

Included with this soil in mapping are a few areas of Plainfield soils and some small areas of wet, sandy soils in depressions that have a surface layer which is thicker and darker colored than the one in this Gotham soil.

Runoff is slow, and the hazard of erosion is slight. Soil blowing is a hazard.

Most areas of this soil are in pasture. Some areas are in pine plantations. This soil is poorly suited to row crops, oats, and alfalfa. Crop yields are generally limited by low available water capacity. Controlling erosion and soil blowing are important factors of good management. Capability unit IVs–3; woodland group 3s1.

Gravel Pits

Gp—Gravel pits consist of areas where sand and gravel or bedrock have been removed to a depth of at least several feet. These pits are in outwash, glacial till, limestone, or sandstone. Most areas are elongated or oblong and range from 5 to more than 80 acres in size.

Included with these miscellaneous areas in mapping are areas of soil material pushed from the pit and stones or boulders too large to crush. A few abandoned pits now have water in the bottom.

Gravel pits are scattered throughout the county, but they are mostly in the areas of glacial outwash in the western part of the county. Many of these pits were still in use at the time this survey was made. Not assigned to a capability unit or woodland group.

Halder Series

The Halder series consists of nearly level and gently sloping, somewhat poorly drained soils on stream terraces. These soils formed in silty and loamy sediment that is underlain by sand and gravel. Native vegetation was mainly elm, ash, and white pine. Unless these soils are drained, the subsoil is saturated by ground water throughout most of the year.

In a representative profile the surface layer is about 9 inches of very dark grayish brown silt loam. The subsurface layer is brown silt loam about 3 inches thick. The subsoil is about 16 inches thick. In the upper part it is yellowish brown, friable, mottled silt loam, and in the lower part it is brown, very friable, mottled sandy clay loam and heavy sandy loam. The substratum, to a depth of about 60 inches, is strong brown sand and gravel.

Available water capacity is moderate, and permeability ranges from moderate in the upper part of the soil to rapid in the underlying sand and gravel. Natural fertility is medium. These soils have a seasonal high water table at a depth of 1 to 3 feet. Depth of the root zone is limited for most crops by a high water table in the subsoil.

Most areas of these soils are in permanent pasture and woods. Some areas are used for corn, oats, and hay.

Representative profile of Halder silt loam, 0 to 3 percent slopes, in a cultivated area, 45 yards east and 150 yards south of center of SW¼, Sec. 13, T. 30 N., R. 16 W.:

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, light brownish gray (10YR 6/2) dry; moderate coarse subangular blocky structure that parts to weak medium granules; friable; many roots; medium acid; abrupt smooth boundary.

A2—9 to 12 inches; brown (10YR 5/3) silt loam; common fine prominent yellowish red (5YR 4/8) mottles; weak medium and thick platy structure; very friable; common roots; medium acid; abrupt wavy boundary.

B&A—12 to 16 inches; yellowish brown (10YR 5/4) silt loam (B21t); common fine prominent yellowish red (5YR 4/8) mottles; moderate medium and fine subangular blocky structure; penetrated by brown (10YR 5/3) tongues of silt loam (A2); weak thin platy structure; friable; common roots; medium acid; clear wavy boundary.

B21t—16 to 21 inches; yellowish brown (10YR 5/4) heavy silt loam; many, fine and medium prominent yellowish red (5YR 4/8) and few fine prominent light brownish gray (10YR 6/2) mottles; moderate medium subangular blocky structure; friable; few thin patchy clay films on surface of peds; common roots; strongly acid; abrupt smooth boundary.

IIB22t—21 to 25 inches; brown (10YR 5/3) sandy clay loam; many medium prominent reddish brown (5YR 4/4) and few fine prominent light brownish gray (10YR 6/2) mottles; weak medium subangular blocky structure; very friable; few thin patchy clay films on surfaces of peds; few pebbles; few roots; strongly acid; gradual irregular boundary.

IIB3—25 to 28 inches; brown (10YR 5/3) heavy sandy loam; many medium prominent yellowish red (5YR 4/6) and few fine prominent light brownish gray (10YR 6/2) mottles; weak fine subangular blocky structure; very friable; few roots; about

10 percent coarse fragments by volume; strongly acid; abrupt smooth boundary.

IIC—28 to 60 inches; strong brown (7.5YR 5/6) sand and gravel; single grained; loose; about 15 percent coarse fragments by volume; medium acid.

The solum ranges from 20 to 40 inches in thickness. The silty mantle is less than 25 inches thick. The Ap horizon is dark gray, very dark gray, dark brown, or very dark grayish brown silt loam or loam 6 to 10 inches thick.

The lower part of the B horizon is sandy clay loam, loam, or sandy loam. The C horizon is 10 to 20 percent coarse fragments.

Halder soils are near Antigo and Rib soils. Halder soils have a thinner silty mantle and are more poorly drained than Antigo soils. They are better drained and have a thinner silty mantle than Rib soils.

HaA—Halder silt loam, 0 to 3 percent slopes. This soil is in drainageways and depressions of stream terraces. Most areas are elongated or oblong and range from 10 to 30 acres in size.

Included with this soil in mapping are small areas of Rib soils and Fluvaquents. Also included are a few areas along streams where the substratum is loamy sand.

This soil has a high water table at a depth of 1 to 3 feet throughout most of the year. Runoff is slow. This soil is ponded or flooded, especially early in spring and after rains. Surface drainage helps remove runoff water. Ditches and tile drains help lower the water table. Where tile drainage is used, loose sand and silt enters tile lines unless precautions are taken to prevent this.

Most areas of this soil are used for pasture or hayland. If adequately drained, this soil is moderately well suited to corn. The main concern of management is removing excess water. Capability unit IIw–5; woodland group 3o2.

Hesch Series

The Hesch series consists of gently sloping to moderately steep, well drained soils on sandstone uplands. These are fine sandy loam soils underlain by a stratified loamy and sandy substratum weathered from sandstone bedrock. Native vegetation was mainly prairie grasses.

In a representative profile the surface layer is about 19 inches thick. It is very dark grayish brown and dark brown fine sandy loam. The subsoil is very friable fine sandy loam about 15 inches thick. In the upper part it is brown and in the lower part it is dark yellowish brown. The substratum, to a depth of about 54 inches, is strong brown loamy fine sand and yellowish brown fine sandy loam. Below this, to a depth of 60 inches, it is white fine sand.

Available water capacity is moderate, and permeability ranges from moderately rapid in the surface layer and subsoil to moderate in the loamy part of the substratum. Natural fertility is medium.

Most areas of these soils are used for corn, oats, and alfalfa. Some of the steeper soils are used for pasture and woodland.

Representative profile of Hesch fine sandy loam, 2 to 6 percent slopes, in a cultivated area, 330 yards north and 110 yards west of center of SE¼, sec. 27, T. 28 N., R. 18 W.:

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) fine sandy loam, grayish brown (10YR 5/2) dry; moderate medium subangular blocky structure; very friable; common roots; medium acid; abrupt smooth boundary.

A12—6 to 16 inches; very dark grayish brown (10YR 3/2) fine sandy loam, grayish brown (10YR 5/2) dry; weak coarse subangular blocky structure; very friable; common roots; medium acid; clear smooth boundary.

A13—16 to 19 inches; dark brown (10YR 3/3) fine sandy loam, grayish brown (10YR 5/2) dry; weak coarse subangular blocky structure; very friable; common roots; medium acid; clear smooth boundary.

B1—19 to 22 inches; brown (10YR 4/3) fine sandy loam; moderate medium subangular blocky structure; very friable; few roots; strongly acid; clear smooth boundary.

B2t—22 to 26 inches; brown (10YR 4/3) heavy fine sandy loam; moderate coarse subangular blocky structure; very friable; dark brown (7.5YR 4/4) thin patchy clay films on surfaces of peds; few roots; strongly acid; clear smooth boundary.

B22t—26 to 34 inches; dark yellowish brown (10YR 4/4) fine sandy loam; weak coarse subangular blocky structure; very friable; dark brown (7.5YR 4/4) thin patchy clay films on surfaces of peds; few roots; strongly acid; clear wavy boundary.

C1—34 to 40 inches; strong brown (7.5YR 5/6) loamy fine sand; single grained; loose; very strongly acid; clear wavy boundary.

C2—40 to 54 inches; yellowish brown (10YR 5/4) fine sandy loam; massive, breaking to single grained; loose; very strongly acid; abrupt smooth boundary.

C3—54 to 60 inches; white (10YR 8/1) fine sand; single grained; loose; very strongly acid.

The solum ranges from 30 to 40 inches in thickness. Depth to cemented sandstone is more than 5 feet. The A horizon is very dark grayish brown, very dark brown, or dark brown and 10 to 20 inches thick.

The B horizon is fine sandy loam or light loam. In places the C horizon contains some sandstone and limestone fragments.

The depth to soft sandstone in these Hesch soils is more than the 20 to 40 inches defined as the range for the series, but this difference does not alter the usefulness or behavior of these soils.

Hesch soils are near Dakota and Nickin soils. The solum of Hesch soils contains less silt and clay than is typical of Dakota and Nickin soils. Also, Hesch soils are underlain by sandy and loamy materials, whereas Dakota soils are underlain by sand and gravel.

HeB—Hesch fine sandy loam, 2 to 6 percent slopes. This soil is in valleys of sandstone uplands. Most areas are elongated or oblong and range from 5 to 30 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Arland, Boone, and Nickin soils. Also included are a few small areas where slopes are less than 2 percent or more than 6 percent.

Runoff is slow, and the hazard of erosion is slight. This soil is subject to soil blowing.

Most areas of this soil are cultivated. The soil is moderately well suited to corn, oats, alfalfa, and grasses. Controlling erosion and soil blowing are important factors of good management. Capability unit IIIe–4; woodland group 3o1.

HeC2—Hesch fine sandy loam, 6 to 12 percent slopes, eroded. This soil is in valleys and foot slopes of sandstone uplands. Most areas are elongated or oblong and range from 5 to 20 acres in size.

This soil has a profile similar to the one described as representative of the series, but the surface layer is slightly thinner and lighter colored.

Included with this soil in mapping are small areas of Arland, Boone, and Nickin soils. Also included are a few areas on the crest of knolls where the soil is severely eroded and a few areas where the soil is underlain by weakly cemented sandstone.

Runoff is medium, and the hazard of erosion is moderate.

Most areas of this soil are cultivated. The soil is suited to alfalfa, grasses, and a limited amount of corn. Controlling erosion and maintaining organic matter content are important factors of good management. Capability unit IIIe–2; woodland group 3o1.

HeD2—Hesch fine sandy loam, 12 to 20 percent slopes, eroded. This soil is in valleys, on foot slopes, and on knolls of sandstone uplands. Most areas are elongated or round and range from 5 to 40 acres.

This soil has a profile similar to the one described as representative of the series, but the surface layer is thinner and lighter colored and the subsoil is thinner.

Included with this soil in mapping are small areas on knolls and in small convex areas where the soil is severely eroded, and a few small areas of Arland, Boone, and Nickin soils. Also included are a few areas where the soil is underlain by limestone or weakly cemented sandstone and a few areas where slopes are less than 12 percent or more than 20 percent.

Runoff is rapid, and the hazard of erosion is severe.

Most areas of this soil are in pasture or woodland. The soil is poorly suited to row crops but is moderately well suited to alfalfa and grasses. Controlling erosion is an important factor of good management. Capability unit IVe–2; woodland group 3r1.

Hubbard Series

The Hubbard series consists of nearly level to sloping, somewhat excessively drained soils on stream terraces and outwash plains. These soils formed in sandy outwash. Native vegetation was prairie grasses.

In a representative profile the surface layer is very dark brown loamy sand about 18 inches thick. The next layer is dark brown sand about 4 inches thick. The substratum, to a depth of about 60 inches, is brown and brownish yellow sand.

Available water capacity is low, and permeability is rapid. Natural fertility is low. The organic matter content of the surface layer is moderately low.

Most areas of these soils are in pasture, woodland, or pine plantations. A few nearly level and gently sloping areas are used for corn, soybeans, and garden vegetables. Where these soils are irrigated and fertilized, they are well suited to potatoes and other special crops.

Representative profile of Hubbard loamy sand, 0 to 6 percent slopes, in an abandoned field, 200 yards north and 200 yards west of southeast corner of NW¼, sec. 13, T. 29 N., R. 20 W.:

A—0 to 18 inches; very dark brown (10YR 2/2) loamy sand; weak medium granular structure parting to single grained; very friable; common roots; strongly acid; abrupt wavy boundary.

AC—18 to 22 inches; dark brown (7.5YR 3/2) medium sand; very weak coarse subangular blocky structure parting to single grained; very friable; common roots; strongly acid; clear wavy boundary.

C1—22 to 26 inches; brown (7.5YR 4/4) medium sand; weak coarse subangular blocky structure parting to single grained; very friable; common roots; strongly acid; clear smooth boundary.

C2—26 to 60 inches; brownish yellow (10YR 6/6) sand; single grained; loose; few roots; slightly acid.

The solum ranges from 10 to 24 inches in thickness. The A horizon is black, very dark brown, or very dark grayish brown loamy fine sand or loamy sand 10 to 24 inches thick.

The AC horizon is sand or loamy sand. The C horizon is less than 15 percent gravel. The A horizon is medium acid to strongly acid, and the C horizon is strongly acid to medium acid.

Hubbard soils are near Burkhardt and Plainfield soils and Hubbard, loamy substratum. They lack the loamy C horizon typical of Hubbard, loamy substratum, soils. They have a thicker, darker colored A horizon than Plainfield soils. They have less clay and silt in the solum and have less gravel in the C horizon than Burkhardt soils.

HrB—Hubbard loamy sand, 0 to 6 percent slopes. This soil is on stream terraces and outwash plains. Most areas are oblong or irregular in shape and range from 10 to 60 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are a few small areas where the surface layer is fine sandy loam. Also included are a few small areas where erosion has removed most of the surface layer.

Runoff is very slow, and the hazard of erosion is slight. Soil blowing is a hazard.

Most areas of this soil are used for pasture and hayland but some row crops are grown. This soil is suited to row crops, hay, and pasture but crop yields are limited by low available water capacity. The soil is well suited to pine plantations. Where this soil is in large tracts and is irrigated and fertilized, it is well suited to growing vegetables or other high value crops. Controlling soil blowing is an important factor of good management. Capability unit IVs–3; woodland group 3s1.

HsB—Hubbard loamy sand, loamy substratum, 0 to 6 percent slopes. This soil is on stream terraces. Most

areas are elongated or irregular in shape and range from 5 to 60 acres in size.

This soil has a profile similar to the one described as representative of the series, but it contains slightly more silt or clay, and it is underlain by silt loam, loam, or sandy loam which is lacking in the soil described as representative.

Included with this soil in mapping are a few small areas where the surface layer is sandy loam or fine sandy loam. Also included are a few small areas that have a loamy subsoil, a few small areas that have a sandy rather than a loamy substratum, and a few areas where slopes are more than 6 percent.

Runoff is very slow, and the hazard of erosion is slight. This soil is subject to soil blowing. Available water capacity is moderate, and permeability in the substratum ranges from moderate to moderately slow.

Most areas of this soil are cultivated. The soil is moderately well suited to corn, oats, alfalfa, and grasses. Where this soil is in large tracts and is irrigated, it is well suited to vegetables or other high value crops. Controlling erosion and soil blowing are important factors of good management. Capability unit IIIe–4; woodland group 3s1.

HsC—Hubbard loamy sand, loamy substratum, 6 to 12 percent slopes. This soil is in areas of pitted outwash plains and on stream terraces. Most areas are elongated or irregular in shape and range from 10 to 40 acres in size.

This soil has a profile similar to the one described as representative of the series, but it contains slightly more silt or clay, and it is underlain by silt loam, loam, or sandy loam which is lacking in the soil described as representative.

Included with this soil in mapping are a few small areas of soils that have a sandy rather than a loamy substratum, a few small areas where the surface layer is fine sandy loam, and a few areas of Plainfield soils. Also included are some areas of this soil where slopes are less than 6 percent or more than 12 percent.

Runoff is slow, and the hazard of erosion is slight. This soil is subject to soil blowing. Available water capacity is moderate, and permeability in the substratum ranges from moderate to moderately slow.

Most areas of this soil are used for pasture or hayland. Many areas are used for pine plantations. This soil is suited to pasture, hay, and row crops grown in rotation. The main concerns of management are controlling erosion and soil blowing. Capability unit IVe–4; woodland group 3s1.

Huntsville Series

The Huntsville series consists of nearly level and gently sloping, well drained and moderately well drained soils in large drainageways and on flood plains. These soils formed mainly in dark colored silty alluvium. Native vegetation was mainly prairie grasses. In some areas, the lower part of these soils is saturated with water for relatively long periods during the year.

In a representative profile the surface layer is about 55 inches thick. It is a very dark brown and black silt loam in the upper part and black silt loam and loam in the lower part. The substratum, to a depth of about 60 inches, is dark brown sandy loam.

Available water capacity is very high, and permeability is moderate. Natural fertility and the organic matter content of the surface layer are high. These soils are occasionally flooded or ponded by runoff and stream overflow for short periods. They are susceptible to streambank erosion and gully erosion.

Most areas of these soils are used for pasture. Where erosion and flooding are controlled, they are used for corn and other row crops.

Representative profile of Huntsville silt loam, 0 to 3 percent slopes, in a cultivated field, 50 yards north and 110 yards east of southwestern corner of NW¼, sec. 14, T. 28 N., R. 18 W.:

Ap—0 to 6 inches; very dark brown (10YR 2/2) silt loam; weak coarse subangular blocky structure parting to very fine subangular blocks; friable; many roots; slightly acid; abrupt smooth boundary.

A12—6 to 24 inches; very dark brown (10YR 2/2) silt loam; weak coarse subangular blocky structure; very friable; common roots; slightly acid; clear smooth boundary.

A13—24 to 44 inches; black (10YR 2/1) silt loam; weak thick platy structure that parts to weak medium plates, lower part of horizon nearly massive; friable; common roots to a depth of 36 inches; slightly acid; clear smooth boundary.

A14—44 to 55 inches; black (10YR 2/1) loam; weak medium subangular blocky structure; friable; mildly alkaline; clear smooth boundary.

C—55 to 60 inches; dark brown (10YR 3/3) sandy loam; few fine prominent yellowish brown (10YR 5/6) and dark grayish brown (10YR 4/2) mottles; massive; very friable; organic coatings on sand; mildly alkaline.

The solum ranges from 30 to 60 inches in thickness. The silty alluvium is more than 40 inches thick. The A horizon is dark brown, very dark brown, or black and 24 to 50 inches thick.

The C horizon ranges from silt loam to sandy loam. The A horizon is slightly acid to mildly alkaline, and the C horizon is mildly alkaline.

Huntsville soils are near Fluvaquents, wet, and Orion soils. They are better drained and lack the stratified silts and fine sands typical of Fluvaquents, wet. They are better drained and have a thicker, dark colored A horizon than Orion soils.

HuA—Huntsville silt loam, 0 to 3 percent slopes. This soil is in drainageways and on flood plains. Most areas are elongated and range from 5 to 20 acres in size.

Included with this soil in mapping are areas where the surface layer is loam. Also included are small areas of Fluvaquents, wet, and Orion soils.

This soil is occasionally flooded by runoff and stream overflow for short periods. Runoff is slow and ponds for short periods. Seasonal wetness often delays tillage. Shallow ditches and waterways help remove runoff water. Water diversions and dikes help prevent flooding. Where this soil is cultivated or overgrazed, streambank and gully erosion are hazards. Fencing cattle from streambanks, riprap along streambanks, and grassed waterways help control erosion.

Most areas of this soil are in pasture. Where erosion and flooding are controlled, the soil is well suited to corn and other row crops. Capability unit IIw–11; woodland group 2o1.

Jewett Series

The Jewett series consists of nearly level to sloping, well drained soils in till plains, ridges, and wide drainageways of ground moraines. These soils formed in silty sediment and the underlying reddish sandy loam and loam till. Native vegetation was mainly native prairie grasses and oak savanna.

In the representative profile the surface layer is very dark grayish brown silt loam about 9 inches thick (fig. 5). The subsurface layer is dark grayish brown silt loam 2 inches thick. The subsoil is about 26 inches thick. In the upper part it is brown, friable silt loam; in the middle part it is brown, friable heavy loam; and in the lower part it is yellowish red, friable, sandy loam. The substratum, to a depth of about 60 inches, is yellowish red sandy loam.

Available water capacity is high, and permeability is moderate. Natural fertility and the organic matter content of the surface layer are high.

Most areas of these soils are cultivated; they are used to grow corn, oats, and alfalfa.

Representative profile of Jewett silt loam, 2 to 6 percent slopes, in a cultivated field, 200 yards south and 80 yards east of center of southwest corner of sec. 19, T. 30 N., R. 17 W.:

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam; moderate medium subangular blocky structure; friable; many roots; neutral; abrupt smooth boundary.

A2—9 to 11 inches; dark grayish brown (10YR 4/2) silt loam; weak medium subangular blocky structure parting to weak thick platy; friable; common roots; some very dark grayish brown (10YR 3/2) earthworm casts and coatings in root channels; slightly acid; abrupt smooth boundary.

B1—11 to 19 inches; brown (7.5YR 4/4) silt loam; moderate fine and medium subangular blocky structure; friable; few thin patchy clay films; common roots; strongly acid; clear smooth boundary.

IIB2t—19 to 26 inches; brown (7.5YR 4/4) heavy loam; moderate medium and coarse subangular blocky structure; friable; thin patchy clay films on faces of peds; common roots; band of cobblestones and pebbles in upper part; strongly acid; gradual wavy boundary.

IIB3—26 to 37 inches; yellowish red (5YR 5/6) heavy sandy loam; weak coarse subangular blocky structure; friable; few thin patchy clay films on faces of peds; common roots; cobblestones and pebbles common; medium acid; gradual wavy boundary.

IIC—37 to 60 inches; yellowish red (5YR 5/6) sandy loam; massive; friable; few roots; bands of loamy sand and loam till; common cobblestones and pebbles; medium acid.

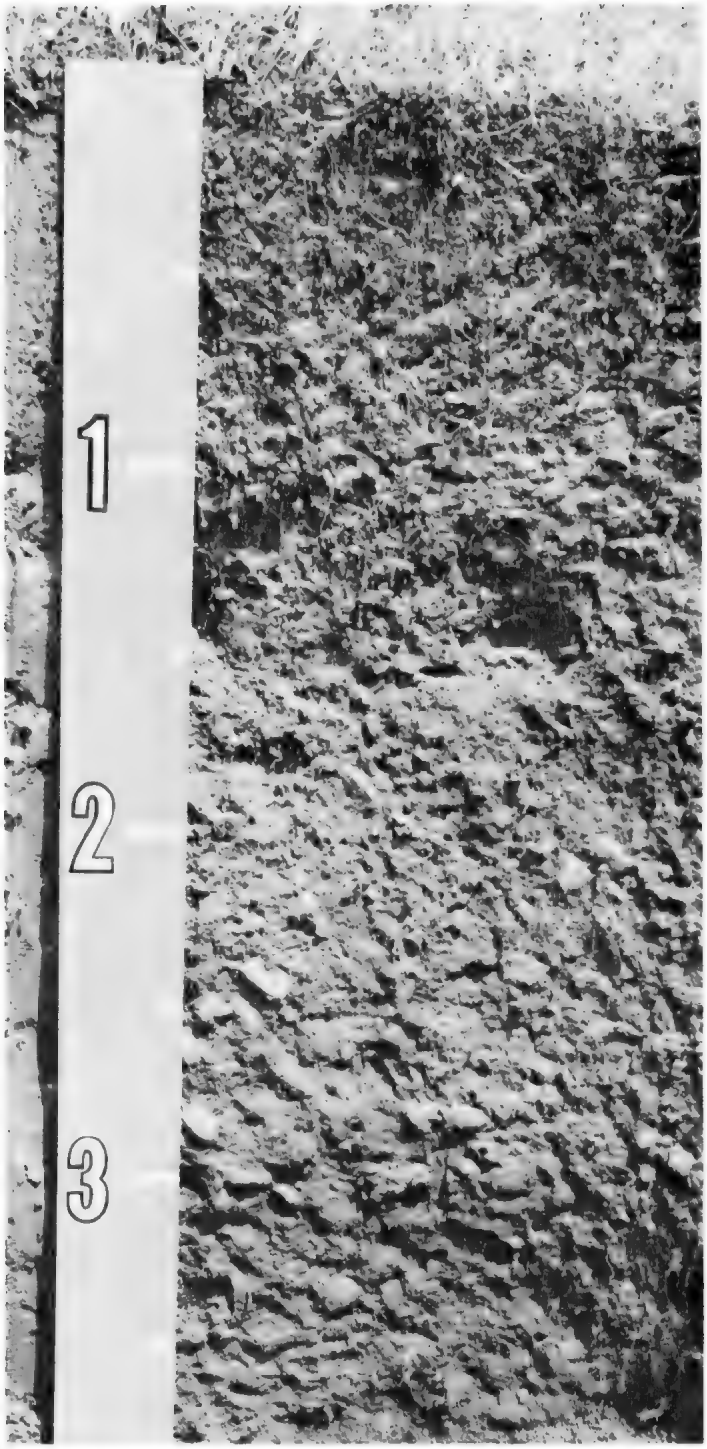


Figure 5.—**Profile of Jewett silt loam that is underlain by sandy loam till at a depth of about 3 feet.**

The solum ranges from 20 to 40 inches in thickness. The silty mantle is 15 to 25 inches thick. The Ap horizon is very dark brown or very dark grayish brown and 6 to 10 inches thick.

The C horizon is 0 to 15 percent coarse fragments. The subsoil is strongly acid or medium acid, and the substratum is slightly acid to strongly acid.

Jewett soils are near Santiago and Sattre soils and Jewett, sandy substratum. They have a darker A horizon than Santiago soils. They have a B horizon that formed mainly in reddish till rather than in the outwash sediment typical of the Sattre soils. They have a C horizon that contains less sand than Jewett, sandy substratum, soils.

JeA—Jewett silt loam, 0 to 2 percent slopes. This soil is on till plains of ground moraines. Most areas are oblong and range from 10 to 40 acres in size.

This soil has a profile similar to the one described as representative of the series, but the surface layer is darker and the silt mantle is slightly thicker in most places.

Included with this soil in mapping are a few areas where the soil is underlain by heavy loam or light clay loam till and a few small areas of Jewett, sandy substratum, soils and Sattre soils. Also included, mainly in drainageways, are small areas where the surface layer is dark colored and 20 to 30 inches thick and a few small depressions where the silty mantle is 30 to 60 inches thick.

Runoff is slow, and the hazard of erosion is slight. Almost all areas of this soil are cultivated. The soil is well suited to such row crops as corn. Maintaining soil structure and organic matter content are important factors of good management. Capability unit I–4; woodland group 2o1.

JeB—Jewett silt loam, 2 to 6 percent slopes. This soil is on ridges and till plains of ground moraines. Most areas are oblong or irregular in shape and range from 10 to 120 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are a few areas where the soil is underlain by heavy loam or clay loam till, a few areas of Jewett, sandy substratum, soils and Sattre soils on knolls and along drainageways and small depressions where the silty mantle is 30 to 60 inches thick. Also included are a few small areas where slopes are slightly less than 2 percent or more than 6 percent.

Runoff is slow, and the hazard of erosion is slight.

Most areas of this soil are cultivated. The soil is well suited to corn, oats, and alfalfa. Controlling erosion and maintaining tilth and organic matter content are important factors of good management. Capability unit IIe–1; woodland group 2o1.

JeC2—Jewett silt loam, 6 to 12 percent slopes, eroded. This soil is on ridges of ground moraines. Most areas are elongated or irregular in shape and range from 5 to 15 acres in size.

This soil has a profile similar to the one described as representative of the series, but the surface layer and subsoil are thinner.

Included with this soil in mapping are a few small areas on knolls, a few small convex areas where the soil is severely eroded, and areas where the soil is underlain by sandstone or limestone bedrock at a depth of 4 to 6 feet. Also included are a few small areas of Jewett, sandy substratum, soils and a few areas where slopes are slightly less than 6 percent or more than 12 percent.

Runoff is medium, and the hazard of erosion is moderate. In most areas erosion has caused the tilth to deteriorate and has reduced the content of organic matter in the surface layer.

Most areas of this soil are cultivated. The soil is suited to oats, alfalfa, and a limited amount of corn. Controlling erosion and maintaining tilth and organic matter content are important factors of good management. Capability unit IIIe–1; woodland group 2o1.

JsA—Jewett silt loam, sandy substratum, 0 to 2 percent slopes. This soil is on benches and large drainageways of ground moraines. It formed in reddish sandy loam till underlain by sand and gravel. Most areas are oblong and range from 10 to 60 acres in size.

This soil has a profile similar to the one described as representative of the series, but the substratum contains more sand and gravel and the surface layer is darker colored.

Included with this soil in mapping are a few small areas of Jewett, Pillot, and Sattre soils.

Runoff is slow, and the hazard of erosion is slight. Available water capacity is moderate, and permeability in the substratum is rapid. Natural fertility is medium.

Most areas of this soil are cultivated. The soil is moderately well suited to corn and other row crops. Maintaining organic matter content and soil structure are important factors of good management. Capability unit IIs–1; woodland group 2o1.

JsB—Jewett silt loam, sandy substratum, 2 to 6 percent slopes. This soil is on benches and large drainageways of ground moraines. It formed in reddish sandy loam till underlain by sand and gravel. Most areas are oblong or irregular in shape and range from 10 to 120 acres in size.

This soil has a profile similar to the one described as representative of the series, but the substratum contains more sand and gravel.

Included with this soil in mapping are a few small areas of other Jewett soils and Sattre soils. Also included are a few areas where slopes are less than 2 percent or more than 6 percent.

Runoff is slow, and the hazard of erosion is slight. Available water capacity is moderate, and permeability in the substratum is rapid. Natural fertility is medium.

Most areas of this soil are cultivated. The soil is moderately well suited to corn, soybeans, oats, and alfalfa. Controlling erosion and maintaining tilth and organic matter content are important factors of good management. Capability unit IIe–2; woodland group 2o1.

Lawler Series

The Lawler series consists of nearly level and gently sloping, somewhat poorly drained soils in depressions and drainageways of stream terraces and outwash plains. These loamy soils are underlain by sand and gravel. Native vegetation was mainly sedges and other water-tolerant prairie grasses. The subsoil of these soils is saturated with water for relatively long periods during the year.

In a representative profile the surface layer is silt loam about 13 inches thick. In the upper part it is black and in the lower part it is very dark grayish brown. The subsoil is about 26 inches thick. In the upper part it is brown and grayish brown, friable, mottled silt loam, and in the lower part it is grayish brown, friable, mot-

tled loam and dark yellowish brown, friable, mottled sandy loam. The substratum, to a depth of about 60 inches, is light yellowish brown sand and gravel.

Available water capacity is moderate, and permeability is moderate in the subsoil and rapid in the sandy substratum. Natural fertility is medium. The organic matter content of the surface layer is high. Depth of the root zone is limited for most farm crops by the wet subsoil.

Most areas of these soils are in pasture but some drained areas are cropped.

Representative profile of Lawler silt loam, 0 to 3 percent slopes, in a cultivated area, 320 yards west of the southeast corner of sec. 17, T. 28 N., R. 18 W.:

Ap—0 to 10 inches; black (10YR 2/1) silt loam; moderate medium subangular blocky structure; friable; common roots; neutral; abrupt smooth boundary.

A12—10 to 13 inches; very dark grayish brown (10YR 3/2) silt loam that has common, black (10YR 2/1) worm castings; moderate medium and fine subangular blocky structure; friable; common roots; slightly acid; clear smooth boundary.

B1—13 to 22 inches; brown (10YR 4/3) silt loam; few fine prominent strong brown (7.5YR 5/8) mottles; weak fine subangular blocky structure; friable; common roots; slightly acid; clear wavy boundary.

B21—22 to 29 inches; grayish brown (10YR 5/2) silt loam; common fine distinct and prominent brown (7.5YR 4/4) and strong brown (7.5YR 5/8) mottles; moderate medium and fine subangular blocky structure; friable; common roots; slightly acid; clear wavy boundary.

IIB22—29 to 34 inches; grayish brown (10YR 5/2) loam; many fine and medium faint to prominent gray (10YR 5/1), brown (7.5YR 4/4), and strong brown (7.5YR 5/8) mottles; moderate medium and fine subangular blocky structure; friable; few roots; slightly acid; clear wavy boundary.

IIB3—34 to 39 inches; dark yellowish brown (10YR 4/4) sandy loam; many fine and medium distinct and prominent grayish brown (10YR 5/2), light brownish gray (10YR 6/2), and strong brown (7.5YR 5/8) mottles; weak medium and fine subangular blocky structure; friable; few roots; few pebbles and cobblestones; slightly acid; clear wavy boundary.

IIC—39 to 60 inches; light yellowish brown (10YR 6/4) sand and gravel, a few limestone fragments; common fine distinct and prominent light brownish gray (10YR 6/2) and strong brown (7.5YR 5/8) mottles; single grained; loose; about 10 percent coarse fragments by volume; neutral.

The solum ranges from 30 to 40 inches in thickness. The silt mantle is 15 to 30 inches thick. The A horizon is black, very dark brown, very dark gray, or very dark grayish brown and 10 to 20 inches thick.

The lower part of the B horizon is loam or sandy loam. The C horizon is 5 to 15 percent coarse fragments. The B horizon is medium acid or slightly acid, and the C horizon is slightly acid or neutral.

Lawler soils are near Dakota, Halder, and Sattre soils. They are more poorly drained than Dakota soils. They are more poorly drained and have a thicker A horizon than Sattre soils. They have a thicker, darker colored A horizon than Halder soils.

LcA—Lawler silt loam, 0 to 3 percent slopes. This soil is in drainageways and depressions on stream terraces and outwash plains. Most areas are elongated or oblong and range from 10 to 30 acres in size.

Included with this soil in mapping are a few areas where the surface layer is sandy loam and areas where the soil has a depth to sand and gravel of more than 40 inches. Also included are a few small areas of Huntsville soils, and Fluvaquents, wet, and Saprists and Aquents.

Runoff is slow, and runoff water ponds. The subsoil is saturated with water throughout most of the year. This soil is flooded for short periods. These wet conditions delay tillage and generally limit crop yields. Surface drains help remove runoff water. Tile drains help drain the wet subsoil. Where tile drainage is used, loose sand and silt enter tile lines unless precautions are taken to prevent this.

Where excess water is removed, this soil is moderately well suited to corn or row crops. Removing excess water and maintaining tilth and organic matter content are important factors of good management. Capability unit IIw–5; woodland group 4o1.

Magnor Series

The Magnor series consists of nearly level and gently sloping, somewhat poorly drained soils in drainageways of ground moraines. These soils formed in silty sediment and the underlying sandy loam till. Native vegetation was mainly red maple, sugar maple, basswood and elm. Unless these soils are drained, the subsoil is saturated with water throughout most of the year.

In a representative profile the surface layer is very dark brown silt loam about 4 inches thick. The subsurface layer is about 14 inches of pale brown, mottled silt loam. The subsoil is about 14 inches thick. It is brown, firm, mottled loam in the upper part and reddish brown, friable, mottled, heavy sandy loam in the lower part. The substratum, to a depth of about 60 inches, is yellowish red, friable, mottled sandy loam.

Available water capacity is high, and permeability is moderately slow. Natural fertility is medium. The organic matter content of the surface layer is moderate. Depth of the root zone is somewhat limited for most farm crops by a perched water table in the subsoil.

Most areas of these soils are used for pasture and woodland. Some areas are used for corn, oats, and hay. Where excess water is removed, these soils are used for corn, oats, hay, and other crops commonly grown in the county.

Representative profile of Magnor silt loam, 1 to 6 percent slopes, in a wooded area, about 325 yards south and 150 yards east of northwest corner of NE¼, sec. 29, T. 31 N., R. 16 W.:

A1—0 to 4 inches; very dark brown (10YR 2/2)

silt loam; moderate medium granular structure; very friable; many roots; slightly acid; abrupt wavy boundary.

A2—4 to 10 inches; pale brown (10YR 6/3) silt loam; moderate medium and thin platy structure; friable; common roots; medium acid; clear wavy boundary.

A&B—10 to 18 inches; pale brown (10YR 6/3) tongues of silt loam (A2); weak thin platy structure; yellowish brown (10YR 5/6) silt loam (Bt); moderate medium subangular blocky structure; common medium faint light brownish gray (10YR 6/2) and common medium prominent brownish yellow (10YR 6/6) mottles; friable; few roots; strongly acid; clear wavy boundary.

IIB2t—18 to 25 inches; brown (7.5YR 5/4) loam; common medium distinct light brownish gray (10YR 6/2) and many fine and medium prominent strong brown (7.5YR 5/8) mottles; moderate medium subangular blocky structure; firm; few roots; about 5 percent coarse fragments by volume; thin patchy clay films; strongly acid; clear wavy boundary.

IIB3—25 to 32 inches; reddish brown (5YR 4/4) heavy sandy loam; few fine prominent light brownish gray (10YR 6/2) and few fine prominent strong brown (7.5YR 5/8) mottles; weak medium and coarse subangular blocky structure; friable; about 10 percent coarse fragments; strongly acid; clear wavy boundary.

IIC—32 to 60 inches; yellowish red (5YR 4/6) sandy loam; few fine and medium distinct strong brown (7.5YR 5/8) mottles; massive; friable; about 5 percent coarse fragments by volume; medium acid.

The solum ranges from 30 to 42 inches in thickness. The silty mantle is 15 to 30 inches thick. In uncultivated areas the A horizon is black and 2 to 4 inches thick. In cultivated areas, the Ap horizon is dark gray or dark grayish brown and 6 to 10 inches thick.

The IIC horizon is a sandy loam or light loam. The IIB and IIC horizons are 5 to 20 percent coarse fragments. The B horizon is strongly acid and the C horizon is medium acid.

Magnor soils are near Adolph and Freeon soils. They are slightly better drained than Adolph soils and lack the gray colors typical of Adolph soils. They are more poorly drained than Freeon soils.

MaB—Magnor silt loam, 1 to 6 percent slopes. This soil is in drainageways and depressions of ground moraines. Most areas are oblong or elongated and range from 5 to 120 acres in size.

Included with this soil in mapping are small areas of Adolph and Freeon soils.

This soil has a seasonal high, perched water table at a depth of 1 to 3 feet. Runoff is slow, and the hazard of erosion is slight. The soil is ponded or flooded in some places during wet seasons. Shallow surface ditches, water diversions, and waterways help remove runoff water. Tile drains help lower the perched water table. Where tile drainage is used, loose sand can enter tile lines unless precautions are taken to prevent this.

Most areas of this soil are used for pasture and woodland. Some areas are in corn, oats, and hay. Where excess water is removed and tilth is maintained, this soil is moderately well suited to most crops. Capability unit IIw–4; woodland group 2o2.

Nickin Series

The Nickin series consists of gently sloping to moderately steep, well drained soils on ridges and foot slopes of sandstone uplands that are covered by a thin mantle of glacial till. These soils formed in silty sediment and the underlying loamy glacial till that in turn are underlain by loose sand weathered from sandstone bedrock. Native vegetation was prairie grasses or oak savanna.

In a representative profile the surface layer is about 11 inches of very dark brown silt loam. The subsoil is about 23 inches thick. It is dark brown, friable silt loam in the upper part and dark brown, friable and very friable loam and sandy loam in the lower part. The substratum, to a depth of about 60 inches, is very pale brown sand.

Available water capacity is moderate, and permeability is moderate in the subsoil and moderately rapid in the substratum. Natural fertility is medium. The organic matter content of the surface layer is high.

Most areas of these soils are cultivated. The gently sloping and sloping soils are used for corn, oats, and alfalfa. The moderately steep soils are used for hay, pasture, or woodland.

Representative profile of Nickin silt loam, 6 to 12 percent slopes, eroded, in a cultivated field, 220 yards east and 220 yards north of southwest corner of SE¼, sec. 36, T. 30 N., R. 18 W.:

Ap—0 to 8 inches; very dark brown (10YR 2/2) silt loam, high fine sand content; weak fine and medium subangular blocky structure; friable; many roots; slightly acid; abrupt smooth boundary.

A12—8 to 11 inches; very dark brown (10YR 2/2) silt loam; weak medium and fine subangular blocky structure; friable; many roots; slightly acid; clear wavy boundary.

B1—11 to 16 inches; dark brown (7.5YR 4/4) silt loam; weak medium and fine subangular blocky structure; friable; common roots; slightly acid; clear smooth boundary.

B21t—16 to 23 inches; dark brown (7.5YR 4/4) heavy silt loam; moderate medium subangular blocky structure; friable; common roots; thin patchy clay films; medium acid; clear wavy boundary.

IIB22t—23 to 29 inches; dark brown (7.5YR 4/4) loam, high silt content; moderate medium and coarse subangular blocky structure; friable; common roots; thin patchy clay films; about 15 percent gravel by volume; strongly acid; clear wavy boundary.

IIB3—29 to 34 inches; dark brown (7.5YR 4/4) sandy loam; weak medium and fine subangular blocky structure; very friable; common roots; about 5 percent gravel by

volume; strongly acid; abrupt wavy boundary.

IIIC—34 to 60 inches; very pale brown (10YR 7/3) sand; single grained; loose; medium acid.

The solum ranges from 23 to 39 inches in thickness. In most places the silty mantle is 15 to 30 inches thick. The A horizon is black, very dark brown, or dark brown silt loam or loam 10 to 20 inches thick.

The IIB horizon is 5 to 15 percent pebbles and cobblestones. The C horizon is sand weathered from sandstone and is underlain by weakly cemented sandstone at a depth of more than 5 feet. The B horizon is slightly acid to strongly acid, and the C horizon is medium acid.

Nickin soils are near Arland, Jewett, and Pillot soils. Their B horizon contains less silt and their C horizon contains less gravel than the B and C horizons of Pillot soils. They have an A horizon that is thicker and a C horizon that contains less sand and clay than these horizons in Jewett soils. They have thicker, darker colored A horizon than Arland soils.

NcB—Nickin silt loam, 2 to 6 percent slopes. Most areas of this soil are on ridges of ground moraines that are underlain by sand weathered from sandstone bedrock. Most areas are oblong or irregular in shape and range from 10 to 60 acres in size.

This soil has a profile similar to the one described as representative of the series, but the surface layer is slightly thicker and darker colored, the silty mantle is thicker, and the subsoil is slightly thicker.

Included with this soil in mapping are some areas where the surface layer is fine sandy loam, a few small areas of Arland and Jewett soils, and areas of moderately well drained Nickin soils in drainageways. Also included are a few small areas where the soil is underlain by limestone bedrock at a depth of about 5 to 6 feet, a few small areas where clayey bands are in the sandstone residuum, and a few areas where slopes are less than 2 percent or more than 6 percent.

Runoff is slow, and the hazard of erosion is slight.

Most areas of this soil are cultivated. The soil is moderately well suited to corn, oats, and alfalfa. It is frequently used for corn. Controlling erosion and maintaining soil structure are important factors of good management. Capability unit IIe–2; not assigned to a woodland group.

NcC2—Nickin silt loam, 6 to 12 percent slopes, eroded. This soil is on ridges and foot slopes of ground moraines and is underlain by sand weathered from sandstone bedrock. Most areas are oblong or elongated and range from 5 to 20 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are some areas where the surface layer is fine sandy loam, and a few small areas of Arland and Jewett soils. Also included are a few areas where the soil is underlain by limestone bedrock at a depth of about 5 or 6 feet, a few areas where clayey bands are in the sandstone residuum, and a few areas where slopes are less than 6 percent or more than 12 percent.

Runoff is medium, and the hazard of erosion is moderate.

Most areas of this soil are cultivated. The soil is suited to oats, alfalfa, and a limited amount of corn. Controlling erosion is an important factor of good management. Capability unit IIIe–2; not assigned to a woodland group.

NnD2—Nickin loam, 12 to 20 percent slopes, eroded. This soil is on foot slopes and knolls of sandstone uplands. Most areas are elongated or round and range from 5 to 30 acres in size.

This soil has a profile similar to the one described as representative of the series, but the surface layer is slightly thinner and lighter colored, and the silty mantle and subsoil are thinner.

Included with this soil in mapping are small areas on knolls and small convex areas where the soil is severely eroded, a few areas where the surface layer is sandy loam, and a few small areas of soils that are underlain by limestone bedrock at a depth of more than 5 feet. Also included are a few small areas where slopes are less than 12 percent or more than 20 percent.

Runoff is rapid, and the hazard of erosion is severe.

Most areas of this soil are used for pasture or hayland. Some areas are wooded. This soil is poorly suited to row crops but is moderately well suited to hay and pasture. Controlling erosion is an important factor of good management. Capability unit IVe–2; not assigned to a woodland group.

Onamia Series

The Onamia series consists of gently sloping to steep, well drained soils on outwash plains and areas of pitted outwash plains. These are loamy soils underlain by sand and gravel. Native vegetation was mainly white pine, sugar maple, and red oak.

In a representative profile the surface layer is about 5 inches of dark grayish brown loam. The subsurface layer is about 2 inches of brown loam. The subsoil is about 25 inches thick. It is brown, friable loam in the upper part and brown, very friable sandy loam in the lower part. The substratum, to a depth of about 60 inches, is strong brown sand and gravel.

Available water capacity is moderate, and permeability is moderate in the subsoil and rapid in the sand and gravel. Natural fertility is medium.

Most of the gently sloping to sloping soils are in corn, oats, and alfalfa. Moderately steep and steep soils are in pasture and woods.

Representative profile of Onamia loam, from an area of Onamia-Antigo complex, 6 to 12 percent slopes, eroded, 300 yards east and 100 yards south of northwest corner of SE¼, sec. 15, T. 30 N., R. 19 W.:

Ap—0 to 5 inches; dark grayish brown (10YR 4/2) loam, high silt content; weak medium subangular blocky structure parting to weak medium granules; friable; common roots; slightly acid; abrupt smooth boundary.

A&B—5 to 7 inches; brown (10YR 5/3) loam, high silt content (A2); moderate medium platy structure; brown (7.5YR 4/4) loam tongues (Bt) extend into this horizon; weak subangular blocky structure; friable; common roots; medium acid; abrupt smooth boundary.

B21t—7 to 12 inches; brown (7.5YR 4/4) loam, high silt content; moderate medium sub-

angular blocky structure; friable; bleached silt and very fine sand coatings on ped faces; interfingering of A2 soil material along ped faces; common roots; strongly acid; abrupt smooth boundary.

B22t—12 to 17 inches; brown (7.5YR 4/4) heavy loam; moderate medium and coarse subangular blocky structure; friable; bleached silt and very fine sand coatings and thin patchy clay films on ped faces; common roots; very strongly acid; clear wavy boundary.

B23t—17 to 28 inches; brown (7.5YR 4/4) loam, high sand content; moderate medium and coarse subangular blocky structure; friable; thin patchy clay films on ped faces; about 5 percent coarse fragments by volume; common roots; strongly acid; clear wavy boundary.

B3—28 to 32 inches; brown (7.5YR 4/4) sandy loam; weak medium subangular blocky structure breaking to single grained; very friable; about 10 percent coarse fragments by volume; few roots; medium acid; abrupt smooth boundary.

C—32 to 60 inches; strong brown (7.5YR 5/6) sand and gravel; single grained; loose; about 15 percent coarse fragments by volume; slightly acid.

The solum ranges from 24 to 40 inches in thickness. The Ap horizon is dark grayish brown, dark brown, or very dark grayish brown loam or silt loam. In some wooded areas the surface layer is very dark brown or black loam or silt loam less than 6 inches thick.

The B horizon is loam or sandy clay loam. The C horizon is 0 to 15 percent coarse fragments. The B horizon is very strongly acid to medium acid, and the C horizon is slightly acid to medium acid.

Onamia soils are near Antigo and Chetek soils. Onamia soils lack the moderately thick silty mantle typical of Antigo soils. They are deeper to sand and gravel and contain less sand in the solum than Chetek soils.

OmB—Onamia loam, 2 to 6 percent slopes. This soil is on areas of pitted outwash and outwash plains. Most areas are oblong or irregular in shape and range from 10 to 30 acres in size.

This soil has a profile similar to the one described as representative of the series, but the surface layer is slightly darker colored and has a higher silt content.

Included with this soil in mapping are some areas of Dakota and Sattre soils. Also included are a few areas where the surface layer is sandy loam.

Runoff is slow, and the hazard of erosion is slight.

This soil is moderately well suited to corn, oats, and alfalfa. Controlling erosion is an important factor of good management. Capability unit IIe–2; woodland group 2o1.

OmC2—Onamia loam, 6 to 12 percent slopes, eroded. This soil is on areas of pitted outwash and outwash plains. Most areas are elongated or irregular in shape and range from 5 to 20 acres in size.

This soil has a profile similar to the one described as representative of the series, but the surface layer contains slightly less silt and more sand.

Included with this soil in mapping are a few areas of Dakota and Sattre soils and a few areas where the surface layer is sandy loam. Also included are a few small areas where slopes are less than 6 percent or more than 12 percent.

Runoff is medium, and the hazard of erosion is moderate. In most places erosion has caused tilth to deteriorate and has reduced the content of organic matter in the surface layer.

This soil is suited to oats, alfalfa, corn, and other row crops. Controlling erosion and maintaining tilth and organic matter content are important factors of good management. Capability unit IIIe–2; woodland group 2o1.

OnC2—Onamia-Antigo complex, 6 to 12 percent slopes, eroded. The soils in this complex are on areas of pitted outwash plains. Most areas are irregular in shape and range from 10 to 120 acres in size. The surface layer in this complex is mainly loam and silt loam but it is sandy loam or loamy sand in some small areas.

This complex is about 45 percent Onamia soils, 40 percent Antigo soils, and 15 percent other soils, mainly Chetek and Burkhardt soils. The Onamia, Chetek, and Burkhardt soils are mainly on eroded, steeper parts of knolls. The Antigo soil is mainly on foot slopes of knolls, in slight depressions, and near drainageways.

The Onamia soil in this complex has the profile described as representative of the series. The Antigo soil has a profile similar to the one described as representative of the series, but the surface layer and silty mantle are more eroded and thinner. Some soils in the drainageways and depressions have a thick, dark colored surface layer.

Included with these soils in mapping are a few wet soils in depressions and drainageways, a few areas where the soil is gravelly and sandy and is severely eroded, a few wooded areas that are not eroded, and a few areas near the base of knolls where the silty sediment is thick. Also included are a few small areas of soils where most of the subsoil formed in reddish colored sandy loam and loam till that is underlain by sand and gravel, and some areas where slopes are less than 6 percent or more than 12 percent.

Runoff is medium, and the hazard of erosion is moderate. In most cultivated soils, erosion of the surface layer has caused tilth to deteriorate and has reduced the content of organic matter. Coarse fragments are on the surface in areas of more severely eroded soils.

Most areas of this complex are cultivated. These soils are suited to oats, alfalfa, and a limited amount of corn or other row crops. Controlling erosion and maintaining tilth and organic matter content are important factors of good management. Capability unit IIIe–2; woodland group 2o1.

OnD2—Onamia-Antigo complex, 12 to 25 percent slopes, eroded. The soils in this complex are on areas of pitted outwash plains. Most areas are irregular in shape and range from 10 to 100 acres in size. The surface layer in this complex is mainly silt loam and loam, but it is sandy loam or loamy sand on the steep parts of the complex.

This complex is about 50 percent Onamia soil, 30 percent Antigo soil, and 20 percent other soils, mainly Chetek and Burkhardt soils. The Onamia, Chetek, and Burkhardt soils are mainly on eroded, steeper parts of

knolls. The Antigo soil is on foot slopes of knolls or in slight depressions and near drainageways.

The Onamia soil has a profile similar to the one described as representative of the series, but the surface layer and subsoil contain more sand in some areas or more silt in other areas. The Antigo soil has a profile similar to the one described as representative of the series, but the silty mantle and surface layer are more eroded and thinner. Some areas in depressions and drainageways have a thick, dark colored surface layer.

Included with these soils in mapping are a few wet soils in depressions and drainageways, wooded areas where the soil is not eroded, and areas of gravel and sand where the soil is severely eroded. Also included are some areas near the base of knolls where the silty sediment is thick, a few small areas of soils where most of the subsoil formed in reddish colored sandy loam and loam till underlain by sand and gravel, and a few areas where slopes are less than 12 percent or more than 25 percent.

Runoff is rapid, and the hazard of erosion is severe. In most cultivated areas, erosion of the surface layer has caused tilth to deteriorate and has reduced the content of organic matter. Coarse fragments are on the surface of severely eroded soils.

Much of this complex has been cleared and cultivated, but some extensive areas are still wooded. These soils are poorly suited to row crops but are suited to grasses and alfalfa. Some of the steeper soils are wooded or in pasture. These soils are well suited to red and white pine. Slopes facing south and southwest are more droughty and are less suited to trees than other areas. Controlling erosion and maintaining tilth and organic matter content are important factors of good management. Capability unit IVe–2; woodland group 2r1.

Orion Series

The Orion series consists of nearly level and gently sloping, somewhat poorly drained soils in depressions and drainageways and on flood plains. These soils formed in silty alluvium. Native vegetation was sedges, grasses, and water tolerant shrubs. Unless these soils are drained, they are saturated with water below the soil surface for long periods throughout most of the year.

In a representative profile the surface layer is very dark grayish brown silt loam about 8 inches thick. The substratum, to a depth of 24 inches, is dark grayish brown and very dark grayish brown, very friable and friable, mottled silt loam. This is underlain by an old buried surface layer that is about 16 inches thick. It is very dark gray and black, mottled silt loam. The lower part of the substratum, to a depth of about 60 inches, is grayish brown, firm, mottled silt loam.

Available water capacity is very high, and permeability is moderate. Natural fertility and the organic matter content of the surface layer are high. Water is ponded in spring and after periods of heavy rain. These soils are frequently flooded for short periods. Depth of the root zone is somewhat limited for most farm crops by a seasonal high water table.

Most areas of these soils are cultivated. Where protected from flooding and where excess water is removed, the soils are used for corn and other row crops.

Representative profile of Orion silt loam, 0 to 3 percent slopes, in a cultivated area, 350 yards south and 60 yards west of northeast corner of SE¼, sec. 26, T. 30 N., R. 15 W.:

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, light brownish gray (10YR 6/2) dry; moderate coarse and medium subangular blocky structure; very friable; common roots; neutral; abrupt smooth boundary.

C1—8 to 18 inches; dark grayish brown (10YR 4/2) silt loam; few fine prominent yellowish brown (10YR 5/6) mottles; moderate coarse subangular blocky structure parting to weak thick platy; very friable; common roots; neutral; clear wavy boundary.

C2—18 to 21 inches; very dark grayish brown (10YR 3/2) silt loam; few fine prominent reddish brown (5YR 4/4) mottles; moderate medium prismatic structure parting to moderate, coarse subangular blocky that displays thin platiness; friable; common roots; slightly acid; clear wavy boundary.

C3—21 to 24 inches; very dark grayish brown (10YR 3/2) silt loam; few medium prominent reddish brown (5YR 4/4) mottles; moderate very thick platy structure; very friable; common roots; slightly acid; clear wavy boundary.

A11b—24 to 30 inches; very dark gray (10YR 3/1) silt loam; few fine distinct dark reddish brown (5YR 3/3) mottles; moderate medium subangular blocky structure; friable; common roots; neutral; clear wavy boundary.

A12b—30 to 40 inches; black (10YR 2/1) silt loam; few fine distinct dark reddish brown (5YR 3/3) mottles; weak medium subangular structure; firm; slightly acid; clear smooth boundary.

Cg—40 to 60 inches; grayish brown (2.5Y 5/2) silt loam; common medium prominent strong brown (7.5YR 5/6) mottles; massive; firm; neutral.

The silty alluvium is more than 40 inches thick. The Ap horizon is very dark grayish brown, very dark brown, or black and 6 to 10 inches thick.

The C horizon is silt loam or silty clay loam. These soils range from slightly acid to mildly alkaline.

Orion soils are near Fluvaquents and Fluvaquents wet, and Huntsville soils. They lack the stratified bands of silt and sand typical of Fluvaquents and Fluvaquents, wet. Also, they are not so poorly drained as Fluvaquents, wet. They have a thinner A horizon and are more poorly drained than Huntsville soils.

OrA—Orion silt loam, 0 to 3 percent slopes. This soil is in depressions, in drainageways, and along flood plains. Most areas are oblong or elongated and range from 10 to 100 acres in size.

Included with this soil in mapping are small areas of

Huntsville and Lawler soils, and Fluvaquents, Fluvaquents, wet, and Saprists and Aquents.

This soil is frequently flooded for brief periods, especially in spring and during periods of heavy rain. It also has a seasonal high water table at a depth of 1 to 3 feet. These wet conditions delay tillage and limit crop yields. Shallow ditches and waterways help remove runoff water. Tile drains help lower the seasonal high water table. Where tile drainage is used, loose silt enters tile lines unless precautions are taken to prevent this. Water diversions and dikes help prevent flooding. Erosion on streambanks is a severe hazard. Fencing cattle from streambanks, riprap along streambanks, and grassed waterways help control erosion.

Most areas of this soil are used for corn. Where excess water is removed and the soil is protected from flooding, the soil is moderately well suited to corn and row crops. Controlling erosion along streambanks and maintaining tilth and organic matter content are important factors of good management. Capability unit IIw–13; woodland group 3o2.

Otterholt Series

The Otterholt series consists of gently sloping to moderately steep, well drained soils on ridges and valleys of ground moraines and limestone uplands where the mantle of silt loam is thick. Native vegetation was sugar maple, red oak, basswood, and white pine.

In a representative profile the surface is dark grayish brown silt loam about 8 inches thick. The subsurface layer is about 8 inches of grayish brown silt loam. The subsoil is dark brown and dark yellowish brown, friable and very friable silt loam about 29 inches thick. The substratum, to a depth of about 60 inches, is yellowish brown, very friable silt loam.

Available water capacity is very high, and permeability is moderate. Natural fertility is medium. The organic matter content of the surface layer is moderate.

Most areas of these soils are cultivated. Gently sloping and sloping soils are used for corn, oats, and alfalfa. Steeper soils are used to grow alfalfa, grasses, or hardwood trees.

Representative profile of Otterholt silt loam, 6 to 12 percent slopes, in a cultivated field, 220 yards west and 100 yards north of center of sec. 1, T. 28 N., R. 15 W.:

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam; moderate medium and coarse granular structure; very friable; many roots; neutral; abrupt smooth boundary.

A2—8 to 12 inches; grayish brown (10YR 5/2) silt loam; moderate medium and thick platy structure; very friable; common roots; neutral; clear wavy boundary.

A&B—12 to 16 inches; grayish brown (10YR 5/2) tongues of silt loam (A2); moderate medium and thick platy structure that penetrates dark yellowish brown (10YR 4/4) silt loam (B2t); moderate medium subangular blocky structure; very friable; common roots; neutral; abrupt irregular boundary.

B21—16 to 23 inches; dark brown (7.5YR 4/4) silt loam; moderate medium subangular blocky structure; friable; few thin patchy clay films along root channels; common roots; very strongly acid; clear wavy boundary.

B22t—23 to 31 inches; dark yellowish brown (10YR 4/4) silt loam; moderate medium subangular blocky structure; friable; few thin patchy clay films, especially along root channels; few roots; very strongly acid; clear wavy boundary.

B3—31 to 45 inches; dark yellowish brown (10YR 4/4) silt loam; weak medium subangular blocky structure; very friable; few roots, strongly acid; clear wavy boundary.

C—45 to 60 inches; yellowish brown (10YR 5/6) silt loam; massive; very friable; few roots; medium acid.

The solum ranges from 36 to 48 inches in thickness. The silty mantle is typically 40 to more than 60 inches thick, but is only about 30 inches thick in some areas. The Ap horizon is very dark grayish brown or dark grayish brown and 6 to 10 inches thick.

The C horizon is silt loam, sandy loam, or loam. The B horizon is strongly acid to very strongly acid, and the C horizon is medium acid to slightly acid.

Otterholt soils are near Santiago and Whalan soils. They have a thicker silty mantle than Santiago soils. Their B horizon is not underlain by limestone bedrock within a depth of 20 to 40 inches as is typical of Whalan soils.

OtB—Otterholt silt loam, 2 to 6 percent slopes. This soil is on ridgetops and narrow valley bottoms. Most areas are elongated or oblong and range from 10 to 40 acres in size.

This soil has a profile similar to the one described as representative of the series, but the surface layer is slightly darker and the subsoil has slightly more clay.

Included with this soil in mapping are a few areas along valley foot slopes where the soil is underlain by sand or gravel or by residuum from limestone and sandstone bedrock within a depth of 3 to 4 feet. Also included are a few areas where slopes are slightly less than 2 percent or more than 6 percent.

Runoff is slow, and the hazard of erosion is slight.

Most areas of this soil are cultivated. The soil is well suited to corn, oats, and alfalfa. It is frequently used for corn. Controlling erosion and maintaining soil tilth and soil structure are important factors of good management. Capability unit IIe–1; woodland group 1o1.

OtC—Otterholt silt loam, 6 to 12 percent slopes. This soil is on valleys and ridges. Most areas are oblong or irregular in shape and range from 10 to 100 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are a few areas where the soil is severely eroded and a few areas along foot slopes where the soil is underlain by sand and gravel or by residuum from limestone and sandstone within a depth of 3 to 4 feet. Also included are a few areas where slopes are slightly less than 6 percent or more than 12 percent.

Runoff is medium, and the hazard of erosion is moderate.

Most areas of this soil are cultivated. The soil is

suited to corn and is well suited to oats and alfalfa. Controlling erosion and maintaining soil tilth are important factors of good management. Capability unit IIIe–1; woodland group 1o1.

OtD2—Otterholt silt loam, 12 to 20 percent slopes, eroded. This soil is in valleys. Most areas are elongated or irregular in shape and range from 5 to 20 acres in size.

This soil has a profile similar to the one described as representative of the series, but the surface layer and subsoil are thinner.

Included with this soil in mapping are some areas where the silty mantle is only 3 to 4 feet thick and is underlain by sandy loam or loam glacial till or by sandstone and limestone residuum. Also included are a few areas where slopes are less than 12 percent or more than 20 percent.

Runoff is rapid, and the hazard of erosion is severe. In most places erosion has caused tilth to deteriorate and has reduced the content of organic matter in the surface layer.

Most areas of this soil are in pasture and hay. The soil is moderately well suited to alfalfa and grasses and poorly suited to corn and other row crops. A few areas are wooded. The soil is well suited to sugar maple, red oak, and white pine. Controlling erosion and maintaining tilth and organic matter content are important factors of good management. Capability unit IVe–1; woodland group 1r1.

Pillot Series

The Pillot series consists of nearly level and gently sloping, well drained soils on outwash plains and stream terraces. These soils formed in silty sediment underlain by sand and gravel. Native vegetation was prairie grasses.

In a representative profile the surface layer is about 15 inches of very dark brown silt loam (fig. 6). The subsoil is about 22 inches thick. It is dark brown, friable silt loam in the upper part; dark yellowish brown, friable heavy silt loam in the middle part; and brown, friable loam in the lower part. The substratum, to a depth of about 60 inches, is yellowish brown sand and gravel.

The available water capacity is moderate, and permeability is moderate in the subsoil and rapid in the underlying sand and gravel. Natural fertility and the organic matter content of the surface layer are high.

Most areas of these soils are in corn or other row crops.

Representative profile of Pillot silt loam, 0 to 3 percent slopes, in a cultivated area, 200 yards west and 350 yards south of northeast corner of SE¼, sec. 31, T. 30 N., R. 18 W.:

Ap—0 to 8 inches; very dark brown (10YR 2/2) silt loam; moderate medium subangular blocky structure that parts to moderate fine granular; friable; many roots; neutral; abrupt smooth boundary.

A12—8 to 15 inches; very dark brown (10YR 2/2) silt loam; moderate medium and coarse subangular blocky structure; friable; common roots; slightly acid; gradual smooth boundary.

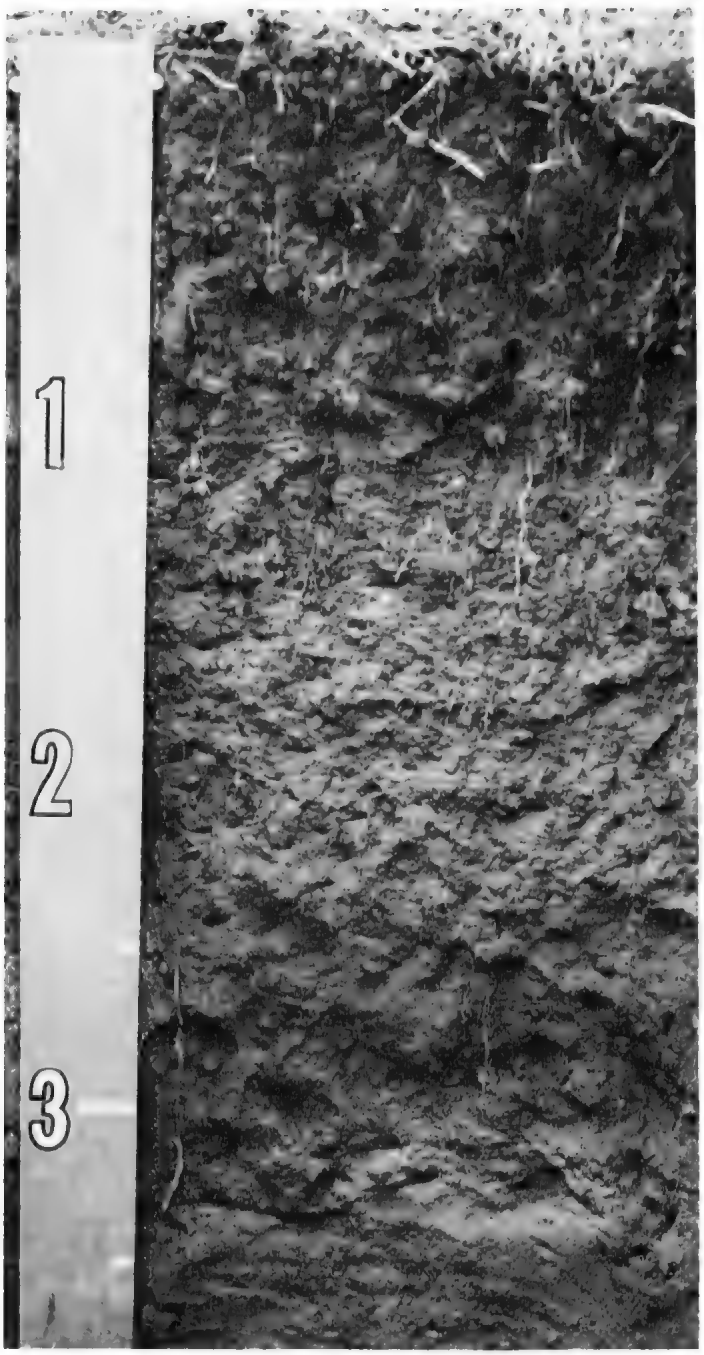


Figure 6.—**Profile of Pillot silt loam. The underlying sand and gravel are at a depth of about 2½ feet.**

B1—15 to 18 inches; dark brown (10YR 4/3) silt loam; weak medium subangular blocky structure; friable; very dark grayish brown (10YR 3/2) organic coatings on faces of peds; slightly acid; clear irregular boundary.

B21t—18 to 25 inches; dark yellowish brown (10YR 4/4) heavy silt loam; moderate medium and coarse subangular blocky

structure; friable; thin continuous clay films; slightly acid; clear wavy boundary.

B22t—25 to 34 inches; dark yellowish brown (10YR 4/4) heavy silt loam; weak coarse and medium subangular blocky structure; friable; thin patchy clay films; medium acid; gradual wavy boundary.

IIB3—34 to 37 inches; brown (7.5YR 4/4) loam; weak medium subangular blocky structure; friable; strongly acid; clear smooth boundary.

IIC—37 to 60 inches; yellowish brown (10YR 5/8) sand and gravel; single grained; loose; about 10 percent coarse fragments by volume; contains many dark colored minerals; slightly acid.

The solum ranges from 26 to 45 inches in thickness. The silty mantle is 24 to 40 inches thick. The A horizon is very dark brown or black and 10 to 18 inches thick.

The C horizon is 0 to 10 percent coarse fragments. The B horizon is slightly acid to strongly acid, and the C horizon is slightly acid to medium acid.

Pillot soils in St. Croix County contain less clay than is defined in the range of the series, but this difference does not alter their usefulness or behavior.

Pillot soils are near Dakota and Sattre soils and Jewett, sandy substratum. They have a silty mantle and contain more silt and less sand than Dakota soils. They have a thicker and darker colored A horizon and a thicker silty mantle than Sattre soils. The B horizon formed mainly in silty sediment, whereas Jewett, sandy substratum soils have B horizons typically formed in sandy loam till. Pillot soils also have a thicker, darker A horizon than Jewett, sandy substratum, soils.

P1A—Pillot silt loam, 0 to 3 percent slopes. This soil is on outwash plains and stream terraces. Most areas are oblong and range from 10 to 160 acres in size.

Included with this soil in mapping are small areas of Dakota and Sattre soils. Also included are a few areas where the depth to sand and gravel is 40 to 50 inches.

Runoff is slow, and the hazard of erosion is slight.

Most areas of this soil are used for crops. The soil is moderately well suited to corn or other row crops. Maintaining tilth and organic matter content are important factors of good management. Capability unit IIs–1; not assigned to a woodland group.

Plainfield Series

The Plainfield series consists of gently sloping to moderately steep, excessively drained soils on stream terraces and outwash plains. These are sandy soils underlain by loose sand. Native vegetation was mainly oak savanna.

In a representative profile the surface layer is about 8 inches of dark brown loamy sand. The subsoil is about 16 inches thick. It is brown, very friable sand. The substratum, to a depth of about 60 inches, is strong brown sand.

Available water capacity is low, and permeability is rapid. Natural fertility and the organic matter content of the surface layer are low.

Most areas of these soils are in pasture, woods, or pine tree plantations. A few gently sloping soils are used for corn, soybeans, and garden vegetables. Where these soils are irrigated and fertilized, they are well suited to potatoes and other special crops.

Representative profile of Plainfield loamy sand, 6 to 12 percent slopes, in a cultivated area, 200 feet south and 50 feet west of center of NE¼ of sec. 21, T. 31 N., R. 19 W.:

Ap—0 to 8 inches; dark brown (10YR 3/3) loamy sand, pale brown (10YR 6/3) dry; weak fine and medium subangular blocky structure; very friable; common roots; slightly acid; abrupt smooth boundary.

B—8 to 24 inches; brown (7.5YR 4/4) sand; weak coarse subangular blocky structure parting to single grained; very friable; few roots; slightly acid; clear wavy boundary.

C—24 to 60 inches; strong brown (7.5YR 5/6) sand; single grained; loose; slightly acid.

The solum ranges from 18 to 34 inches in thickness. The Ap horizon is very dark grayish brown, dark brown, or dark grayish brown loamy sand or sand 6 to 10 inches thick. In some wooded areas the A1 horizon is a very dark brown or black loamy sand that is 2 to 4 inches thick. The C horizon is 0 to 10 percent coarse fragments.

Plainfield soils are near Boone, Gotham, and Hubbard soils. They have a thinner, lighter colored A horizon than Hubbard soils. Their B horizon contains slightly less silt and clay than is typical of Gotham soils. Plainfield soils are underlain by loose outwash sand, whereas Boone soils are typically underlain by weakly cemented sandstone bedrock.

PmB—Plainfield loamy sand, 2 to 6 percent slopes. This soil is on outwash plains and stream terraces. Most areas are oblong or irregular in shape and range from 10 to 40 acres in size.

This soil has a profile similar to the one described as representative of the series, but the surface layer is slightly darker and contains slightly more silt.

Included with this soil in mapping are a few small areas of Hubbard soils, a few areas where the surface layer is sandy loam, and a few areas where slopes are less than 2 percent.

Runoff is very slow, and the hazard of erosion is slight. Soil blowing is a hazard.

This soil is used for farm crops, but crop yields are generally limited by low available water capacity. Some areas are in woodland or planted to pine tree plantations. This soil is poorly suited to most farm crops. Where irrigated, it is used for such row crops as beans and potatoes. Controlling soil blowing is an important factor of good management. Capability unit IVs–3; woodland group 3s1.

PmC—Plainfield loamy sand, 6 to 12 percent slopes. This soil is on outwash plains and stream terraces. Most areas are elongated or irregular in shape and range from 10 to 120 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are a few areas of Emmert soils and a few small areas where slopes are less than 6 percent or more than 12 percent.

Runoff is slow, and the hazard of erosion is slight. Soil blowing is a hazard.

This soil is used mostly for pasture and woodland or pine tree plantations. It is poorly suited to most farm crops. Slopes facing south and southwest are more

droughty and less suited to trees than slopes facing north and northeast. Controlling erosion and soil blowing are important factors of good management. Capability unit VIs–3; woodland group 3s1.

PmD—Plainfield loamy sand, 12 to 20 percent slopes. This soil is on outwash plains and stream terraces. Most areas are elongated and range from 10 to 80 acres in size.

This soil has a profile similar to the one described as representative of the series, but the surface layer and subsoil are thinner, and in places the subsoil is reddish brown.

Included with this soil in mapping are a few areas where slopes are less than 12 percent or more than 20 percent. Also included are a few wooded areas where the surface layer is thin and dark colored.

Runoff is slow, and the hazard of erosion is slight. Soil blowing is a hazard.

Most areas of this soil are in woodland, pine tree plantations, or pasture. The soil is not suited to row crops and is poorly suited to pasture. Slopes facing south and southwest are more droughty and less suited to trees than slopes facing north and northeast. Controlling erosion and soil blowing are important factors of good management. Capability unit VIIs–3, woodland group 3s3.

Port Byron Series

The Port Byron series consists of gently sloping to moderately steep, well drained soils along drainageways, draws, and foot slopes of the uplands. These soils formed in deep, silty sediment. Native vegetation was prairie grasses.

In a representative profile the surface layer is very dark brown silt loam about 13 inches thick. The subsoil is dark yellowish brown, friable and very friable silt loam about 25 inches thick. The substratum, to a depth of about 60 inches, is dark yellowish brown, friable silt loam.

Available water capacity is very high, and permeability is moderate. Natural fertility and the organic matter content of the surface layer are high.

Most areas of these soils are used for corn, oats, and alfalfa.

Representative profile of Port Byron silt loam, 12 to 20 percent slopes, in a cultivated area, 440 yards east and 220 yards south of northwest corner of sec. 36, T. 28 N., R. 19 W.:

Ap—0 to 8 inches; very dark brown (10YR 2/2) silt loam; moderate fine granular structure; very friable; common roots; medium acid; abrupt smooth boundary.

A12—8 to 13 inches; very dark brown (10YR 2/2) silt loam; moderate coarse subangular blocky structure; friable; common roots; medium acid; clear smooth boundary.

B1—13 to 22 inches; dark yellowish brown (10YR 3/4) silt loam; moderate medium subangular blocky structure that parts to weak fine subangular blocks; friable; dark organic coatings on surface of peds; medium; clear smooth boundary.

B21—22 to 29 inches; dark yellowish brown (10YR 3/4) silt loam; moderate medium subangular blocky structure; friable; thin patchy clay films and organic coatings on surface of peds; medium acid; clear smooth boundary.

B22—29 to 34 inches; dark yellowish brown (10YR 4/4) silt loam; moderate medium subangular blocky structure; friable; patchy clay films and organic coatings on surface of peds; medium acid; clear wavy boundary.

B3—34 to 38 inches; dark yellowish brown (10YR 4/4) silt loam; weak coarse subangular blocky structure; very friable; medium acid; clear wavy boundary.

C—38 to 60 inches; dark yellowish brown (10YR 4/4) silt loam; massive; friable; medium acid.

The solum ranges from 36 to 48 inches in thickness. In most places the silty mantle is more than 5 feet thick. The A horizon is very dark brown or black and 10 to 16 inches thick.

The B horizon is silt loam or heavy silt loam. The B horizon is medium acid to strongly acid, and the C horizon is strongly acid to medium acid.

Port Byron soils are near Pillot and Ritchey soils. They have a thicker silty mantle than Pillot soils, and they lack the sandy C horizon typical of those soils. Port Byron soils are deep silty soils, whereas Ritchey soils are typically shallow soils underlain by dolomitic limestone.

PoB—Port Byron silt loam, 2 to 6 percent slopes. This soil is along drainageways and upland draws. Most areas are oblong or irregular in shape and range from 10 to 60 acres in size.

This soil has a profile similar to the one described as representative of the series, but the surface layer is thicker and darker. In most areas this soil is underlain by sand rather than limestone bedrock at a depth of more than 60 inches.

Included with this soil in mapping are a few small areas of Pillot soils. Also included are a few small areas of moderately well drained soils in depressions.

Runoff is slow, and the hazard of erosion is slight.

Most areas of this soil are used for crops. The soil is well suited to corn or other row crops. Controlling erosion and maintaining tilth and organic matter content are important factors of good management. Capability unit IIe–1; not assigned to a woodland group.

PoC—Port Byron silt loam, 6 to 12 percent slopes. This soil is on narrow draws and foot slopes, mainly adjacent to limestone uplands. Most areas are elongated and slightly concave and range from 5 to 30 acres in size.

This soil has a profile similar to the one described as representative of the series, but the surface layer is thicker.

Included with this soil in mapping are a few small areas of Pillot and Rockton soils and a few areas where slopes are less than 6 percent or more than 12 percent.

Runoff is medium, and the hazard of erosion is moderate.

Most areas of this soil are used for crops. The soil is well suited to oats, alfalfa, and pasture. It is suited to growing a limited amount of corn. Controlling erosion and maintaining tilth and organic matter content are

important factors of good management. Capability unit IIIe–1; not assigned to a woodland group.

PoD—Port Byron silt loam, 12 to 20 percent slopes. This soil is on narrow draws and foot slopes adjacent to limestone uplands. Most areas are elongated and range from 10 to 30 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are a few small areas of Ritchey and Rockton soils. Also included are a few areas where slopes are less than 12 percent or more than 20 percent.

Runoff is rapid, and the hazard of erosion is severe.

Most areas of this soil are used for pasture or hayland. The soil is moderately well suited to alfalfa and grasses and is poorly suited to corn. Controlling erosion and maintaining tilth and organic matter content are important factors of good management. Capability unit IVe–1; not assigned to a woodland group.

Renova Series

The Renova series consists of gently sloping and sloping, well drained and moderately well drained soils on ridges and knolls of ground moraines. These soils formed mainly in silty sediment and the underlying firm heavy loam till. Native vegetation was mainly white pine, sugar maple, and red oak.

In a representative profile the surface layer is about 7 inches of dark brown silt loam. The subsurface layer is brown silt loam about 2 inches thick. The subsoil is about 34 inches thick. In the upper part it is dark yellowish brown, friable silt loam and in the lower part it is dark yellowish brown and yellowish brown, firm, mottled, heavy loam. The substratum, to a depth of about 60 inches, is yellowish brown, firm, mottled, heavy loam.

Available water capacity is high, and permeability is moderately slow. Natural fertility is high. The organic matter content of the surface layer is moderate.

Most areas of these soils are used for growing corn, oats, and alfalfa.

Representative profile of Renova silt loam, 6 to 12 percent slopes, eroded, 120 yards north and 540 yards west of the southeast corner of sec. 19, T. 28 N., R. 16 W.:

Ap—0 to 7 inches; dark brown (10YR 4/3) silt loam; moderate medium and fine granular structure; friable; many roots; slightly acid; abrupt smooth boundary.

A2—7 to 9 inches; brown (10YR 4/3) silt loam; moderate medium platy structure; friable; common roots; medium acid; clear wavy boundary.

B21t—9 to 12 inches; dark yellowish brown (10YR 4/4) silt loam; moderate medium subangular blocky structure; friable; thin patchy clay films and uncoated silt and fine grains on faces of peds; common roots; strongly acid; clear wavy boundary.

B22t—12 to 17 inches; dark yellowish brown (10YR 4/4) silt loam, high sand content; few fine distinct yellowish brown (10YR 5/6) mottles; moderate medium and fine subangular blocky structure; friable; thin continuous clay films and uncoated silt and fine sand grains on faces of peds; common roots; strongly acid; clear wavy boundary.

IIB23t—17 to 25 inches; yellowish brown (10YR 5/4) heavy loam; few fine distinct mottles of strong brown (7.5YR 5/6); strong coarse and medium subangular blocky structure; firm; few patchy clay films on faces of peds; thin band of cobblestones and pebbles; few roots; strongly acid; gradual wavy boundary.

IIB31—25 to 33 inches; yellowish brown (10YR 5/4) heavy loam; common, medium prominent strong brown (7.5YR 5/8) and reddish yellow (7.5YR 6/8) mottles; moderate medium prismatic structure parting to weak coarse subangular blocky; firm; about 5 percent coarse fragments by volume; few roots; strongly acid; gradual wavy boundary.

IIB32—33 to 43 inches; dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/4) heavy loam; few fine distinct yellowish brown (10YR 6/6) and few medium and fine distinct light brownish gray (10YR 6/2) mottles; weak coarse prismatic structure parting to weak coarse subangular blocky; firm; about 10 percent coarse fragments by volume; medium acid; gradual wavy boundary.

IIC—43 to 60 inches; yellowish brown (10YR 5/6) heavy loam; few medium distinct light brownish gray (10YR 6/2) mottles; massive; firm; about 10 percent coarse fragments by volume; neutral.

The solum ranges from 38 to 48 inches in thickness. The silty mantle is less than 25 inches thick. The Ap horizon is very dark grayish brown, dark grayish brown, or dark brown silt loam or loam.

The C horizon is heavy loam or sandy clay loam till. A few thin cobbly or gravelly bands are commonly in the B and C horizons. The B and C horizons are 0 to 10 percent coarse fragments. The B horizon is strongly acid to extremely acid, and the C horizon is neutral to mildly alkaline.

Renova soils are near Renova Variant and Skyberg and Vlasaty soils. Renova soils formed in till that has a slightly lower clay content and is less firm than that in which Vlasaty soils formed. They are better drained, have a B horizon that has less gray and more brown colors, and have till that contains slightly more sand than Skyberg soils. Renova soils formed in heavy loam till, whereas Renova Variant soils typically formed in a mixture of loamy and sandy glacial drift.

ReB—Renova silt loam, 2 to 6 percent slopes. This soil is on low ridges and knolls of ground moraines. Most areas are irregular in shape and range from 5 to 20 acres in size.

This soil has a profile similar to the one described as representative of the series, but the surface layer is darker and the silty mantle is thicker.

Included with this soil in mapping are small areas of Renova soils near the crest of knolls and narrow ridges which have a surface layer of sandy loam. Also included are small areas of Renova Variant and Vlasaty soils,

a few areas where the subsoil formed in heavy loam weathered from dolomitic limestone or kaolinitic sandstone, and a few small areas where slopes are less than 2 percent or more than 6 percent.

Runoff is slow, and the hazard of erosion is slight.

This soil is well suited to corn, oats, and alfalfa. It is frequently used for corn. Controlling erosion, especially on long slopes, is an important factor of good management. Capability unit IIe–1; woodland group 2o1.

ReC2—Renova silt loam, 6 to 12 percent slopes, eroded. This soil is on low ridges and knolls of ground moraines. Most areas are irregular in shape and range from 5 to 30 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are a few small areas of Renova soils that have a surface layer of sandy loam. Also included are small areas of Freeon, heavy substratum, and Renova Variant soils; areas of this soil where the subsoil and substratum formed in heavy loam weathered from dolomitic or kaolinitic sandstone; and a few small areas where slopes are less than 6 percent or more than 12 percent.

Runoff is medium, and the hazard of erosion is moderate. In most areas, erosion has caused tilth to deteriorate and has reduced the content of organic matter in the surface layer.

This soil is well suited to oats, alfalfa, and a limited amount of corn. Controlling erosion and maintaining soil tilth are important factors of good management. Capability unit IIIe–1; woodland group 2o1.

Renova Variant

The Renova Variant consists of gently sloping to moderately steep, well drained soils on knolls, narrow ridges and foot slopes of glacial drift. These soils formed in a mixture of loamy and sandy glacial drift. Native vegetation was mainly sugar maple, red oak, and white pine.

In a representative profile the surface layer is about 6 inches of dark brown loam. The subsurface layer is about 2 inches of yellowish brown sandy loam. The subsoil is about 32 inches thick. It is yellowish brown, very friable heavy sandy loam in the upper part; dark yellowish brown and yellowish brown, firm heavy loam in the middle part; and strong brown, very friable sandy loam in the lower part. The substratum, to a depth of about 60 inches, is strong brown loamy sand that has thin bands of sandy clay loam.

Available water capacity ranges from moderate to high, and permeability is moderate. Natural fertility is medium.

Most areas of these soils are sloping or moderately steep. The soils are mainly in permanent pasture and woodland.

Representative profile of Renova Variant loam, 12 to 20 percent slopes, eroded, in a cultivated area, 35 yards east and 300 yards south of the northwest corner of sec. 20, T. 28 N., R. 16 W.:

Ap—0 to 6 inches; dark brown (10YR 3/3) loam; weak fine subangular blocky structure that parts to weak very fine granules; very friable; many roots; medium acid; abrupt smooth boundary.

A2—6 to 8 inches; yellowish brown (10YR 5/4) sandy loam; moderate medium platy structure that parts to weak very fine granules; very friable; many roots; medium acid; abrupt wavy boundary.

B1—8 to 15 inches; yellowish brown (10YR 5/6) heavy sandy loam; weak fine subangular blocky structure; very friable; uncoated silt and very fine sand grains on faces of peds; common roots; about 5 percent coarse fragments by volume; medium acid; clear wavy boundary.

B21t—15 to 27 inches; dark yellowish brown (10YR 4/4) heavy loam; strong medium subangular blocky structure; firm; thin continuous clay films and some uncoated silt and very fine sand grains on faces of peds; common roots; about 5 percent coarse fragments by volume; strongly acid; clear irregular boundary.

B22t—27 to 34 inches; yellowish brown (10YR 5/4) heavy loam; strong medium and coarse subangular blocky structure; firm; thin patchy clay films and some uncoated silt and very fine sand grains on faces of peds; common roots; about 5 percent coarse fragments by volume; very strongly acid; abrupt wavy boundary.

IIB3—34 to 40 inches; strong brown (7.5YR 5/6) sandy loam and loamy sand; weak medium subangular blocky structure that breaks to single grained; very friable; about 10 percent coarse fragments by volume; strongly acid; clear wavy boundary.

IIC—40 to 60 inches; strong brown (7.5YR 5/6) loamy sand that has thin bands of sandy clay loam; single grained; loose; about 15 percent coarse fragments by volume; medium acid.

The solum ranges from 28 to 48 inches in thickness. Where a silty mantle is present, it is 6 to 15 inches thick. The A horizon is very dark brown, dark brown, or dark grayish brown loam or silt loam.

The Bt horizon is a loam, heavy loam, or light clay loam. The C horizon is loamy sand and fine sandy loam that contains bands of sand and gravel and bands of heavy loam or sandy clay loam till. The C horizon is 0 to about 15 percent coarse fragments. The B horizon is medium acid to very strongly acid, and the C horizon is medium acid to slightly acid.

Renova Variant soils are near Renova, Skyberg, and Vlasaty soils. They formed in a mixture of loamy and sandy glacial drift, whereas Renova, Skyberg, and Vlasaty soils typically formed in heavy loam and clay loam till. Also, Renova Variant soils are better drained than the moderately well drained Vlasaty soils and the somewhat poorly drained Skyberg soils.

RgC2—Renova Variant loam, 4 to 12 percent slopes, eroded. This soil is on narrow ridges, valleys, and foot slopes of glacial drift. Most areas are elongated or irregular in shape and range from 5 to 20 acres in size.

This soil has a profile similar to the one described as representative of the series, but the surface layer and subsoil contain slightly more silt.

Included with this soil in mapping are a few areas where thick heavy loam or sandy clay loam bands are

in the substratum and a few areas on narrow ridges, mainly in Kinnickinnic township, where the glacial drift is underlain by shale at a depth of 3 to 5 feet. Also included are a few areas where slopes are less than 4 percent or more than 12 percent.

Runoff is medium, and the hazard of erosion is moderate. Erosion has caused tilth to deteriorate and has reduced the content of organic matter in the surface layer.

This soil is suited to oats, alfalfa, and a limited amount of corn. It is frequently used for hay or pasture. Controlling erosion and maintaining soil tilth are important factors of good management. Capability unit IIIe–2; woodland group 2o1.

RgD2—Renova Variant loam, 12 to 20 percent slopes, eroded. This soil is on knolls and narrow ridges and in valleys of glacial drift. Most areas are elongated or round and range from 5 to 15 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are a few areas of soils that are underlain by thick bands of sandy clay loam or heavy loam and a few areas where slopes are slightly less than 12 percent or more than 20 percent.

Runoff is rapid, and the hazard of erosion is severe. Erosion has caused tilth to deteriorate and has reduced the content of organic matter in the surface layer.

This soil is suited to alfalfa and grasses. It is frequently used for pasture. It is poorly suited to row crops. Some areas are planted to red and white pine. Controlling erosion and maintaining soil tilth are important factors of good management. Capability unit IVe–2; woodland group 2r1.

Rib Series

The Rib series consists of nearly level or gently sloping, poorly drained soils in drainageways of stream terraces and outwash plains. These soils formed mainly in silty sediment underlain by sand and gravel. The native vegetation was mainly grasses, sedges, and willow brush. Unless these soils are drained, ground water is at or near the soil surface throughout most of the year.

In a representative profile the surface layer is black silt loam about 8 inches thick. The subsurface layer is about 6 inches thick. It is dark gray, mottled silt loam. The subsoil is about 16 inches thick. It is dark gray and grayish brown, friable, mottled silt loam in the upper part and grayish brown, friable, mottled loam in the lower part. The substratum, to a depth of about 60 inches, is pale brown sand and gravel.

Available water capacity is moderate, and permeability is moderate in the subsoil and rapid in the substratum. Natural fertility is medium. The organic matter content of the surface layer is moderate. Depth of the root zone is limited for major farm crops by a high water table. These soils are frequently flooded for brief periods early in spring and after heavy rain. They are subject to frost late in spring and early in fall.

Most areas of these soils are used for pasture and wildlife habitat. Where adequately drained, these soils are used for corn or other row crops.

Representative profile of Rib silt loam, 0 to 3 percent slopes, in an uncultivated pasture, 350 yards north and 400 yards east of southwest corner of SE¼, sec. 30, T. 29 N., R. 16 W.:

A11—0 to 4 inches; black (10YR 2/1) silt loam; moderate medium granular structure; friable; many roots; slightly acid; abrupt smooth boundary.

A12—4 to 8 inches; black (10YR 2/1) silt loam; moderate coarse granular structure; friable; many roots; slightly acid; abrupt smooth boundary.

A2g—8 to 14 inches; dark gray (10YR 4/1) silt loam; common fine dark yellowish brown (10YR 4/4) mottles; weak medium platy structure; friable; common roots; slightly acid; abrupt wavy boundary.

B1g—14 to 20 inches; dark gray (10YR 4/1) silt loam; common fine prominent strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; friable; common roots; slightly acid; gradual wavy boundary.

B2g—20 to 25 inches; grayish brown (2.5Y 5/2) heavy silt loam; common fine prominent strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; friable; few roots; neutral; clear wavy boundary.

IIB3g—25 to 30 inches; grayish brown (2.5Y 5/2) loam; many coarse prominent strong brown (7.5YR 5/8) mottles; weak medium and fine subangular blocky structure; friable; mildly alkaline; clear irregular boundary.

IIC—30 to 60 inches; pale brown (10YR 6/3) sand and gravel; common fine prominent strong brown (7.5YR 5/8) mottles; about 10 percent coarse fragments by volume; single grained; loose; mildly alkaline.

The solum ranges from 24 to 36 inches in thickness. The silty mantle is 20 to 36 inches thick. The A horizon is black or very dark gray and 6 to 10 inches thick.

The C horizon is 5 to 15 percent coarse fragments. The B horizon is strongly acid to neutral, and the C horizon is neutral to mildly alkaline.

Rib soils are near Auburndale, Clyde, and Halder soils. They lack the sandy loam or loam C horizon typical of Auburndale soils. The B horizon formed mainly in silt loam sediment, whereas Clyde soils typically have B horizons that formed in heavy loam till. Also, Rib soils have a thinner A horizon than Clyde soils. Rib soils contain more silt and are more poorly drained than Halder soils.

RhA—Rib silt loam, 0 to 3 percent slopes. This soil is in drainageways of stream terraces and outwash plains. Most areas are elongated or oblong and range from 10 to 100 acres in size.

Included with this soil in mapping are a few small areas of Halder soils and Fluvaquents, wet, and Saprists and Aquents.

This soil has a seasonal high water table at a depth of 0 to 1 foot. Runoff is very slow or ponded. This soil is frequently flooded for brief periods early in spring and after heavy rains. Shallow ditches and water diversions help remove runoff water. Tile drains lower the seasonal high water table. Where tile drainage is used,

loose silt and sand enter tile lines unless precautions are taken to prevent this. Also, water diversions and dikes help prevent flooding.

Most areas of this soil are used for pasture and wildlife habitat. Where adequately drained, the soil is moderately well suited to corn or other row crops. Capability unit IIw–5; woodland group 3w2.

Ritchey Series

The Richey series consists of gently sloping to very steep, well drained soils of the limestone uplands. These soils formed in a thin mantle of silty sediment, and the underlying loamy glacial till and limestone residuum. Native vegetation was mainly oak savanna or mixed hardwoods.

In a representative profile the surface layer is about 3 inches of very dark brown silt loam. The subsurface layer is yellowish brown silt loam about 3 inches thick. The subsoil is about 12 inches thick. It is reddish brown, friable silt loam in the upper part and reddish brown, friable heavy loam in the lower part. Fractured brownish yellow dolomitic limestone is at a depth of about 18 inches.

Available water capacity is low, and permeability is moderate. Natural fertility is medium. The organic matter content of the surface layer is moderate. Depth of the root zone is limited for most farm crops by limestone bedrock.

Most areas of these soils are in trees or pasture. The gently sloping and sloping soils are used to grow general farm crops. Steeper soils are in woodland and pasture. In some areas the dolomitic limestone is mined and crushed for fill or liming materials.

Representative profile of Ritchey silt loam, in a wooded area of Ritchey soils and Rock outcrop, 20 to 35 percent slopes, near center of SW¼, NW¼, sec. 25, T. 28 N., R. 19 W.:

A1—0 to 3 inches; very dark brown (10YR 2/2) silt loam; moderate medium granular structure; friable; slightly acid; abrupt wavy boundary.

A2—3 to 6 inches; yellowish brown (10YR 5/4) silt loam; weak fine subangular blocky structure; friable; medium acid; abrupt smooth boundary.

B21t—6 to 10 inches; reddish brown (5YR 4/4) silt loam, high sand content; weak fine and medium subangular blocky structure; friable; thin continuous clay films on most faces of peds; slightly acid; abrupt wavy boundary.

IIB22t—10 to 18 inches; reddish brown (5YR 4/4) heavy loam; moderate medium subangular blocky structure; friable; thin continuous clay films on most faces of peds; about 10 percent coarse fragments by volume; neutral; abrupt smooth boundary.

R—18 inches; fractured brownish yellow (10YR 6/8) dolomitic limestone; moderately alkaline.

The solum thickness and depth to limestone bedrock range from 10 to 20 inches. The A1 horizon is very dark brown or very dark grayish brown. The Ap horizon is very dark brown to dark reddish brown.

The R horizon is dolomitic limestone bedrock that is fractured. These soils are slightly acid to medium acid to neutral in the B horizon.

Ritchey soils are near Nickin and Whalan soils. They have a thinner B horizon than Nickin and Whalan soils. Also, they are underlain by limestone, whereas Nickin soils are typically underlain by sandy materials weathered from sandstone.

RnB—Ritchey silt loam, 2 to 6 percent slopes. This soil is on ridges underlain by limestone bedrock. Most areas are oblong or irregular in shape and range from 5 to 20 acres in size.

This soil has a profile similar to the one described as representative of the series, but most areas are cultivated and the surface layer is thicker and lighter colored than in the representative profile.

Included with this soil in mapping are a few areas of soils that are eroded and have limestone fragments on the surface, and a few areas where the subsoil formed mainly in clayey residuum weathered from limestone or shale. Also included are a few small areas of Derinda, Nickin, and Whalan soils. In some areas the surface layer is sandy loam.

Runoff is slow, and the hazard of erosion is slight. Tillage is difficult where limestone fragments are on or near the soil surface.

This soil is suited to corn, oats, and alfalfa. Controlling erosion is an important factor of good management. Capability unit IIIe–3; woodland group 3d1.

RnC2—Ritchey silt loam, 6 to 12 percent slopes, eroded. This soil is on ridges underlain by limestone bedrock. Most areas are elongated or irregular in shape and range from 5 to 20 acres in size.

This soil has a profile similar to the one described as representative of the series, but most areas are cultivated and the surface layer is thicker and lighter colored than in the representative profile.

Included with this soil in mapping are a few areas that have a surface layer of sandy loam or have limestone fragments on the surface, and a few areas where the subsoil formed mainly in clayey residuum weathered from limestone or shale. Also included are a few small areas of Derinda, Nickin, and Whalan soils.

Runoff is medium, and the hazard of erosion is moderate. Erosion has caused tilth to deteriorate and has reduced the content of organic matter in the surface layer. In some places tillage is made difficult by limestone fragments.

This soil is suited mainly to grasses and alfalfa. It is poorly suited to row crops. Controlling erosion and maintaining tilth and organic matter content are important factors of good management. Capability unit IVe–3; woodland group 3d1.

RnD2—Ritchey silt loam, 12 to 20 percent slopes, eroded. This soil is on narrow ridges, knolls, and moderately steep escarpments that are underlain by limestone bedrock. Most areas are elongated or irregular in shape and range from 10 to 60 acres in size.

This soil has a profile similar to the one described as representative of the series, but the surface layer is lighter colored, and many limestone fragments are on the surface.

Included with this soil in mapping are a few areas

where the subsoil formed mainly in clayey residuum weathered from limestone or shale. Also included are a few areas of rock outcrops and a few small areas of Derinda, Nickin, and Whalan soils.

Runoff is rapid, and the hazard of erosion is severe. In most places, erosion has caused tilth to deteriorate and has reduced the content of organic matter in the surface layer. Shallow depth to limestone bedrock and steep slopes make tillage difficult. Tillage has mixed limestone fragments into the plowed layer in many places.

Most areas of this soil are in pasture. The soil is suited to grasses, alfalfa, and hardwood trees. It is poorly suited to row crops. Slopes facing south and southwest are more droughty and less suited to trees than slopes facing north and northeast. Controlling erosion and maintaining tilth and organic matter content are important factors of good management. Capability unit VIe–3; woodland group 3d2.

RoE—Ritchey soils and Rock outcrop, 20 to 35 percent slopes. This undifferentiated group consists of Rock outcrop and steep and very steep soils of the Ritchey series. The soils are well drained to excessively drained and shallow or very shallow with exposures of bedrock. This undifferentiated group is in areas of the county where bedrock is exposed. These areas are generally underlain by dolomite, but small areas are underlain by sandstone or shale. Ritchey soils and Rock outcrops may occur either separately or together in an individual mapped area. Where both occur together, Rock outcrop makes up about 55 percent of the mapping unit and Ritchey soils make up about 45 percent. Most mapped areas are long and narrow in shape and range from 10 to 120 acres in size.

Most areas of Ritchey soils and Rock outcrop have uniform convex slopes. Soil material covers the rock in some areas and fills crevices in the dolomite. Generally, the soil material is less than 20 inches thick but in some small areas it is 3 to 4 feet thick. The Ritchey soils are silt loam, silty clay loam, loam, clay loam, or sandy loam, and they commonly contain dolomite fragments. Ritchey silt loam has the profile described as representative of the series.

Included in mapping of this undifferentiated group are small areas of Derinda, Nickin, and Whalan soils. Also included are bedrock outcrops where the slopes are vertical or near vertical.

Runoff is medium to very rapid, and the hazard of erosion is moderate to very severe. Management practices are needed that maintain plant cover and reduce erosion.

This undifferentiated group is not suitable for cultivation because of rock fragments and bedrock outcrops. Most areas are in woodland but some are in native grasses. Some areas are pastured, but yields are low. This unit is best suited to recreation or wildlife habitat. Capability unit VIIe–3; woodland group 3d2.

Rockton Series

The Rockton series consists of gently sloping to moderately steep, well drained soils on limestone uplands. These soils formed in a silty mantle and a loamy mixture of till and residuum that is underlain by dolomitic limestone. Native vegetation was prairie grasses.

In a representative profile the surface layer is silt loam about 14 inches thick. It is black in the upper part, very dark brown in the middle part, and very dark grayish brown in the lower part. The subsoil is about 22 inches thick. It is brown, friable silt loam in the upper part and dark reddish brown, very friable sandy loam in the lower part. The substratum is reddish brown, friable sandy loam about 2 inches thick and is underlain by dolomitic limestone at a depth of about 38 inches.

Available water capacity and permeability are moderate. Natural fertility is medium. The organic matter content of the surface layer is high.

Most gently sloping and sloping areas of these soils are in corn, oats, and hay. Most moderately steep areas are in hay, permanent pasture, or woodland.

Representative profile of Rockton silt loam, 2 to 6 percent slopes, in a cultivated area, 200 yards east and 440 yards south of northwest corner of sec. 5, T. 28 N., R. 19 W.:

Ap—0 to 8 inches; black (10YR 2/1) silt loam; moderate fine and medium granular structure; friable; many roots; medium acid; abrupt smooth boundary.

A12—8 to 11 inches; very dark brown (10YR 2/2) silt loam; moderate medium subangular blocky structure; friable; many roots; medium acid; abrupt wavy boundary.

A13—11 to 14 inches; very dark grayish brown (10YR 3/2)silt loam; moderate medium subangular blocky structure; friable; dark grayish brown (10YR 4/2) silt coating on surfaces of peds; many roots; strongly acid; abrupt wavy boundary.

B1—14 to 20 inches; brown (7.5YR 4/4) silt loam; moderate coarse and medium subangular blocky structure; friable; common roots; strongly acid; clear wavy boundary.

B2t—20 to 26 inches; brown (7.5YR 4/4) heavy silt loam; moderate medium subangular blocky structure; friable; thin patchy clay films; few roots; very strongly acid; gradual wavy boundary.

IIB3—26 to 36 inches; dark reddish brown (5YR 3/4) heavy sandy loam; weak medium subangular blocky structure; very friable; about 10 percent coarse fragments by volume; few roots; strongly acid; clear smooth boundary.

IIIC—36 to 38 inches; dark reddish brown (5YR 3/4) sandy loam with heavy loam bands; massive; friable; appears to be mixture of till and limestone residuum; about 10 percent coarse fragments by volume; few roots; moderately alkaline.

R—38 inches; very pale brown (10YR 8/3) fragmented dolomitic limestone bedrock.

The solum thickness and depth to limestone bedrock ranges from 20 to 40 inches. The silty mantle is 15 to 30 inches thick. The A horizon is black to very dark grayish brown and 10 to 15 inches thick.

The B horizon is silt loam or silty clay loam in the upper part and sandy loam or loam in the lower part. The C horizon, where present, is sandy loam to heavy

loam underlain by fractured limestone bedrock. The silty B horizon is strongly acid to very strongly acid, and the C horizon is strongly acid to moderately alkaline.

Rockton soils are near Jewett, Pillot, and Ritchey soils. They have a darker and thicker A horizon and are deeper to limestone bedrock than Ritchey soils. They have a thicker A horizon and formed in thinner till deposits than Jewett soils. They are underlain by dolomitic limestone, whereas Pillot soils typically are underlain by sand and gravel deposits.

RpB—Rockton silt loam, 2 to 6 percent slopes. This soil is on ridges and drainageways of limestone uplands. Most areas are oblong or elongated and range from 10 to 30 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are a few small areas of Ritchey and Whalan soils. Also included are a few small slightly concave areas, mainly in drainageways, where depth to limestone bedrock is more than 40 inches, and a few nearly level areas.

Runoff is slow, and the hazard of erosion is slight.

Most areas of this soil are used for crops. The soil is moderately well suited to corn, oats, and alfalfa. Controlling erosion and maintaining soil tilth and organic matter content are important factors of good management. Capability unit IIe–2; not assigned to a woodland group.

RpC2—Rockton silt loam, 6 to 12 percent slopes, eroded. This soil is on ridges, valleys, and foot slopes of limestone uplands. Most areas are elongated or irregular in shape and range from 5 to 20 acres in size.

This soil has a profile similar to the one described as representative of the series, but the surface layer is thinner and lighter colored.

Included with this soil in mapping are a few small areas of severely eroded Whalan and Ritchey soils on knolls and a few small areas where the lower part of the subsoil is mainly loamy residuum weathered from sandstone and is underlain by limestone bedrock. Also included are a few areas where slopes are less than 6 percent or more than 12 percent.

Runoff is medium, and the hazard of erosion is moderate. In most areas erosion has caused tilth to deteriorate and has reduced the content of organic matter in the surface layer.

Most areas of this soil are cultivated. The soil is suited to oats, alfalfa, and a limited amount of corn. The main concerns of management are controlling erosion and maintaining soil tilth and structure. Capability unit IIIe–2; not assigned to a woodland group.

RpD2—Rockton silt loam, 12 to 20 percent slopes, eroded. This soil is on lower valleys and foot slopes of limestone escarpments. Most areas are elongated or irregular in shape and range from 10 to 20 acres in size.

This soil has a profile similar to the one described as representative of the series, but the surface layer and subsoil are thinner.

Included with this soil in mapping are a few small areas consisting mainly of Ritchey soils that are severely eroded and a few small areas where the subsoil is loamy residuum weathered from sandstone and is underlain by limestone bedrock. Also included are a few small areas where slopes are less than 12 percent or more than 20 percent.

Runoff is rapid, and the hazard of erosion is severe. In most areas erosion has caused tilth to deteriorate and has reduced the content of organic matter in the surface layer.

Most areas of this soil are used for pasture. The soil is well suited to alfalfa and grasses and poorly suited to row crops. Controlling erosion and maintaining tilth and soil structure are important factors of good management. Capability unit IVe–2; not assigned to a woodland group.

Santiago Series

The Santiago series consists of gently sloping to steep, well drained soils on ridges and foot slopes of ground moraines or on pitted glacial drift. These soils formed in silty and loamy sediment and in the underlying sandy loam till. Native vegetation was mainly white pine, red oak, and sugar maple.

In a representative profile the surface layer is about 7 inches of dark grayish brown silt loam. The subsurface layer is brown silt loam about 10 inches thick. The subsoil is about 17 inches thick. It is dark brown, very friable silt loam in the upper part; reddish brown, friable loam in the middle part; and yellowish red, friable, heavy sandy loam in the lower part. The substratum, to a depth of about 60 inches, is yellowish red, friable sandy loam.

Available water capacity is high, and permeability is moderate. Natural fertility is medium. The organic matter content of the surface layer is moderate.

Most areas of these soils are cultivated. Gently sloping to sloping soils are mainly in corn, oats, and alfalfa. Moderately steep to steep soils are mainly in hay, pasture, or woods.

Representative profile of Santiago silt loam, 2 to 6 percent slopes, in a cultivated area, 220 yards east and 60 yards south of northwest corner of SE¼, sec. 34, T. 30 N., R. 16 W.:

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam; weak fine subangular blocky structure; very friable; common roots; neutral (limed); abrupt smooth boundary.

A2—7 to 11 inches; brown (10YR 5/3) silt loam; moderate thick and medium platy structure; very friable; common roots; neutral (limed); clear wavy boundary.

A&B—11 to 17 inches; brown (10YR 5/3) tongues of silt loam (A2); weak thin platy structure; dark brown (10YR 4/3) silt loam (B2t); weak fine subangular blocky structure; very friable; common roots; slightly acid; clear irregular boundary.

B&A—17 to 20 inches; dark brown (7.5YR 4/4) silt loam (B2t); moderate medium subangular blocky structure; penetrated by brown (10YR 5/3) tongues of silt loam (A2); weak thin platy structure; very friable; common roots; medium acid; clear wavy boundary.

IIB21—20 to 24 inches; reddish brown (5YR 4/4) loam; moderate medium subangular blocky structure; few interfingerings of reddish brown (5YR 5/3) loam; friable;

common roots; about 15 percent coarse fragments by volume; strongly acid; clear irregular boundary.

IIB22t—24 to 30 inches; reddish brown (5YR 4/4) heavy loam; moderate medium subangular blocky structure; friable; thin patchy clay films; some uncoated silt and very fine sand grains on faces of peds; common roots; about 15 percent coarse fragments by volume; strongly acid; clear wavy boundary.

IIB3—30 to 34 inches; yellowish red (5YR 4/6) heavy sandy loam; weak medium subangular blocky structure; friable; few roots; about 10 percent coarse fragments by volume; strongly acid; clear wavy boundary.

IIC—34 to 60 inches; yellowish red (5YR 4/6) sandy loam; massive breaking to weak thick plates; friable; few roots; about 10 percent coarse fragments by volume; strongly acid.

The solum ranges from 20 to 40 inches in thickness. The silty mantle is 15 to 25 inches thick. The Ap horizon is very dark grayish brown or dark grayish brown.

The Bt horizon is heavy sandy loam or heavy loam. The C horizon is sandy loam or light loam. In most places the C horizon is 0 to 15 percent coarse fragments. The B horizon is strongly acid, and the C horizon is medium acid to strongly acid.

Santiago soils are near Freeon and Magnor soils. They are better drained than the moderately well drained Freeon soils and the somewhat poorly drained Magnor soils.

SaB—Santiago silt loam, 2 to 6 percent slopes. This soil is on ridges of ground moraines. Most areas are oblong or irregular in shape and range from 10 to 120 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of Amery and Arland soils on knolls and small areas of Freeon and Magnor soils in drainageways. Also included are a few small areas of Freeon, heavy substratum, soils along the lower foot slopes of ridges.

Runoff is slow, and the hazard of erosion is slight.

This soil is well suited to corn, oats, and alfalfa. It is frequently used for corn. Controlling erosion, especially on relatively long slopes, is an important factor of good management. Capability unit IIe–1; woodland group 1o1.

SaC2—Santiago silt loam, 6 to 12 percent slopes, eroded. This soil is on ridges of ground moraines. Most areas are oblong or irregular in shape and range from 5 to 80 acres in size.

This soil has a profile similar to the one described as representative of the series, but the surface layer is slightly lighter colored and the subsoil is thinner.

Included with this soil in mapping are a few small areas of Freeon and Magnor soils in drainageways and a few small areas of Amery soils on knolls. Also included are a few small areas of Freeon, clayey substratum, soils along the foot slopes of ridges and a few small areas where slopes are slightly less than 6 percent or more than 12 percent.

Runoff is medium, and the hazard of erosion is moderate. In most areas erosion has caused tilth to deteriorate and has reduced the content of organic matter in the surface layer.

This soil is suited to oats, alfalfa, and a limited amount of corn. Controlling erosion and maintaining tilth and organic matter content are important factors of good management. Capability unit IIIe–1; woodland group 1o1.

ScC2—Santiago-Antigo complex, 6 to 12 percent slopes, eroded. The soils in this complex are on moraines and pitted glacial drift. Most areas are irregular in shape and range from 10 to 120 acres in size. These soils formed mainly in silty sediment and in the underlying sandy loam till or sand and gravel outwash.

This complex is about 50 percent Santiago silt loam, 25 percent Antigo silt loam, and 25 percent other soils, mainly Onamia soils and loamy till soils underlain by sand and gravel. Positions of these soils on the landscape vary, but generally the Santiago soil is on moderately broad ridges and on slightly concave foot slopes. The Antigo soil is in drainageways, but is also commonly on eroded, convex parts of knolls and ridges.

The Santiago and Antigo soils in this complex have profiles similar to the ones described as representative of their respective series, but they are more eroded and contain slightly more sand. Also, in many places, the Antigo soil has a subsoil that formed partly in reddish sandy loam till, and in places the soils in this complex have a dark surface layer 6 to 10 inches thick.

Included with these soils in mapping are many soils in drainageways that have a dark surface layer 10 to 30 inches thick and small areas of sandy and gravelly soils on the crests of knolls. Also included are many small areas of wet soils and ponds and some small areas where slopes are more than 12 percent.

Runoff is medium, and the hazard of erosion is moderate. In most places erosion has caused tilth to deteriorate and has reduced the content of organic matter in the surface layer.

Most areas of this complex are cultivated. These soils are well suited to oats, alfalfa, and grasses, and are suited to a limited amount of corn. Short steep slopes in this complex are well suited to red and white pines. Controlling erosion and maintaining tilth and organic matter content are important factors of good management. Capability unit IIIe–1; woodland group 1o1.

ScD2—Santiago-Antigo complex, 12 to 25 percent slopes, eroded. The soils in this complex are on end moraines and pitted glacial drift. Most areas are irregular in shape and range from 10 to 100 acres in size. These soils formed mainly in silty sediment and in the underlying sandy loam till or sand and gravel outwash.

This complex is about 40 percent Santiago silt loam, 25 percent Antigo silt loam, and 35 percent other soils, mainly Onamia soils and loamy till soils underlain by sand and gravel. Positions of these soils on the landscape vary, but the Santiago soil commonly is on moderately broad ridges and concave foot slopes. The Antigo and Onamia soils commonly are on knolls, very narrow ridges, and convex parts where the soil is more eroded. They are also in some drainageways.

The Santiago and Antigo soils in this complex have profiles similar to the ones described as representative of their respective series, but they are more eroded

and contain more sand. Also, in many places the Antigo soil has a subsoil that formed partly in reddish sandy loam till.

Included with these soils in mapping are many small areas of soils in drainageways that have a dark surface layer 10 to 30 inches thick, areas of Jewett soils, small areas of sandy and gravelly soils on the crest of knolls, and a few wooded areas where the soils are not eroded. Also included are many small areas of wet soils and ponds and some small narrow areas where slopes are less than 12 percent or more than 25 percent.

Runoff is rapid, and the hazard of erosion is severe. In most places erosion has caused tilth to deteriorate and has reduced the content of organic matter in the surface layer.

Most areas of this complex are in hay or pasture. These soils are moderately well suited to alfalfa and grasses and poorly suited to row crops. The steeper soils in this complex are also well suited to pine plantations (fig. 7) Slopes facing south and southwest are more droughty and less suited to trees than slopes facing north and northeast. Controlling erosion and maintaining tilth and organic matter content are important factors of good management. Capability unit IVe–1; woodland group 1r1.

Saprists and Aquents

Se—Saprists and Aquents consist of very poorly drained organic and mineral soils that are along the edges of lakes, on flood plains along rivers and streams, in blocked drainageways, and in depressions. Most areas are elongated or rounded and range from 5 to 65 acres in size. Slopes are 0 to 2 percent. Native vegetation is sedges, cattails, and other marsh plants that can grow in shallow water. Ground water is near the soil surface or above it throughout the year.

Included with these soils in mapping are small areas of Duelm and Seelyeville soils and Fluvaquents, Fluvaquents, wet, and Udifluvents.

Saprists and Aquents are flooded for long periods and are too wet for growth of farm crops, pasture, or trees. These soils are generally not suited to drainage because of their low position on the landscape. They are best suited to recreation or wetland wildlife habitat, particularly for fur bearers and waterfowl. Capability unit VIIIw–15; woodland group 6w1.

Sattre Series

The Sattre series consists of nearly level to steep, well drained soils on stream terraces, outwash plains,

Figure 7.—**Ski area on moderately steep and steep soils of the Santiago-Antigo complex. This is a limited but popular use of a rough moraine area.**

and knolls of pitted outwash plains. These soils formed mainly in silty and loamy sediment underlain by sand and gravel. The native vegetation was mainly oak savanna.

In a representative profile the surface layer is very dark grayish brown silt loam about 9 inches thick. The subsurface layer is dark grayish brown silt loam about 2 inches thick. The subsoil is about 19 inches thick. In the upper part it is dark yellowish brown, friable silt loam; in the middle part it is dark brown, friable loam; and in the lower part it is dark brown, very friable sandy loam. The substratum, to a depth of about 60 inches, is yellowish brown sand and gravel.

Available water capacity is moderate to low, and permeability ranges from moderate in the subsoil to rapid in the underlying sand and gravel. Natural fertility is medium. The organic matter content of the surface layer is high.

Most areas of these soils are in corn or other row crops, such as soybeans and kidney or navy beans.

Representative profile of Sattre silt loam, 2 to 6 percent slopes, in cultivated area, 40 yards south of center of SW¼, sec. 30, T. 29 N., R. 18 W.:

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam; moderate medium subangular blocky structure parting to moderate medium and fine granular; very friable; common roots; medium acid; abrupt smooth boundary.

A2—9 to 11 inches; dark grayish brown (10YR 4/2) silt loam; weak medium platy structure parting to moderate medium subangular blocky; very friable; common roots; medium acid; clear wavy boundary.

B1—11 to 17 inches; dark yellowish brown (10YR 4/4) silt loam; weak medium subangular blocky structure; friable; common roots; medium acid; clear wavy boundary.

B21t—17 to 21 inches; dark brown (7.5YR 4/4) loam; moderate medium subangular blocky structure; friable; thin continuous clay films; common roots; medium acid; clear wavy boundary.

IIB22t—21 to 26 inches; dark brown (7.5YR 4/4) loam; moderate coarse subangular blocky structure; friable; thin patchy clay films; common roots; strongly acid; clear irregular boundary.

IIB3—26 to 30 inches; dark brown (7.5YR 4/4) sandy loam; weak coarse subangular blocky structure; very friable; few roots; strongly acid; clear wavy boundary.

IIC—30 to 60 inches; yellowish brown (10YR 5/6) sand and gravel containing many pink and dark colored minerals; single grained; loose; about 15 percent coarse fragments by volume; medium acid.

The solum ranges from 24 to 40 inches in thickness. The silty mantle is less than 20 inches thick. The Ap horizon is very dark brown or very dark grayish brown silt loam or loam 6 to 10 inches thick.

The B horizon is silt loam or loam in the upper part and sandy loam or gravelly sandy clay loam in the lower part. The C horizon is 0 to 20 percent coarse fragments. The B horizon is strongly acid or medium acid, and the C horizon is medium acid.

In mapping units ShA, ShB, and ShC2, the B horizon contains less clay than is defined as the range for the series, but this difference does not alter the usefulness or behavior of these soils.

Sattre soils are associated with Burkhardt, Dakota, and Pillot soils. They have a thinner silty mantle and surface layer than Pillot soils. They have a thinner A horizon than Dakota soils. Their solum is thicker and contains more silt and clay than that of Burkhardt soils.

ShA—Sattre loam, 0 to 2 percent slopes. This soil is on outwash plains and stream terraces. Most areas are oblong or irregular in shape and range from 10 to 120 acres in size.

This soil has a profile similar to the one described as representative of the series, but the surface layer is darker colored and the surface layer and subsoil contain more sand.

Included with this soil in mapping are a few areas of Sattre soils where the surface layer is sandy loam.

Runoff is very slow, and the hazard of erosion is slight. Available water capacity is moderate, but ranges to low in many places.

This soil is moderately well suited to corn and such cash crops as beans and peas, but crop yields are generally less than for Sattre soils that have a silt loam surface layer. Irrigation is feasible on some large tracts of this soil where vegetables and high value crops are grown. The main concern of management is maintaining tilth and soil structure. Capability unit IIs–1; woodland group 2o1.

ShB—Sattre loam, 2 to 6 percent slopes. This soil is on outwash plains and stream terraces. Most areas are oblong or irregular in shape and range from 10 to 140 acres in size.

This soil has a profile similar to the one described as representative of the series, but the surface layer and subsoil contain more sand.

Included with this soil in mapping are areas of Sattre soils that have a surface layer of sandy loam and small areas of Burkhardt soils. Also included are a few small areas where slopes are less than 2 percent or more than 6 percent.

Runoff is slow, and the hazard of erosion is slight. Available water capacity is moderate, but ranges to low in many places.

This soil is moderately well suited to most crops commonly grown in the county, but crop yields are generally less than yields of Sattre soils that have a silt loam surface layer. This soil is frequently used for corn, beans, and peas. Irrigation is feasible on some large tracts where vegetables and high value crops are grown. The main concerns of management are controlling erosion and maintaining tilth and soil structure. Capability unit IIe–2; woodland group 2o1.

ShC2—Sattre loam, 6 to 12 percent slopes, eroded. This soil is on stream terraces and knolls of pitted outwash plains. Most areas are irregular or elongated and range from 5 to 30 acres in size.

This soil has a profile similar to the one described as representative of the series, but the surface layer is lighter colored and the surface layer and subsoil contain more sand. Also, as a result of cultivation and erosion,

in most areas some of the subsoil has been mixed into the plow layer.

Included with this soil in mapping are areas of Sattre soils that have a surface layer of sandy loam and small areas of Burkhardt soils. Also included are a few areas where slopes are less than 6 percent or more than 12 percent.

Runoff is medium, and the hazard of erosion is moderate. Available water capacity is moderate, but ranges to low in many places.

Most areas of this soil are used for crops or pasture. The soil is suited to alfalfa, grasses, and a limited amount of row crops. Controlling erosion and maintaining soil tilth and structure are important factors of good management. Capability unit IIIe–2; woodland group 2o1.

S1A—Sattre silt loam, 0 to 2 percent slopes. This soil is on outwash plains and stream terraces. Most areas are irregular or oblong in shape and range from 10 to 140 acres in size.

This soil has a profile similar to the one described as representative of the series, but the surface layer is darker colored and the subsoil is slightly thicker.

Included with this soil in mapping are areas of Sattre loam and areas in depressions where the surface layer is more than 10 inches thick.

Runoff is very slow, and the hazard of erosion is slight.

This soil is moderately well suited to corn and such special cash crops as beans and peas. Irrigation is feasible on some large tracts where vegetables and high value crops are grown. Where these soils are in row crops year after year, the main concern of management is maintaining tilth and soil structure. Capability unit IIs–1; woodland group 2o1.

S1B—Sattre silt loam, 2 to 6 percent slopes. This soil is on outwash plains and stream terraces. Most areas are irregular or oblong in shape and range from 10 to 160 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are a few areas of Sattre loam and a few areas where slopes are slightly less than 2 percent or more than 6 percent.

Runoff is slow, and the hazard of erosion is slight.

This soil is moderately well suited to corn, oats, and alfalfa. It is frequently used for corn, beans, and peas. Irrigation is feasible on some large tracts of this soil where vegetables and high value crops are grown. The main concerns of management are controlling erosion and maintaining tilth and soil structure. Capability unit IIe–2; woodland group 2o1.

Seelyeville Series

The Seeleyville series consists of nearly level, very poorly drained organic soils in drainageways, on flood plains, and in depressions. These soils formed in muck deposits that are more than 50 inches thick. Native vegetation was reeds, sedges, moss, and such trees as tamarack and spruce. Unless these soils are drained, ground water is at or near the surface throughout the year.

In a representative profile the organic layer is black, friable muck about 55 inches thick. The substratum, to a depth of 60 inches, is black loose sand.

Available water capacity is very high, and permeability is moderately rapid. Natural fertility is low. Depth of the root zone is limited for most farm crops by a seasonal high water table at or near the soil surface.

Most areas of these soils are in natural vegetation. The soils are well suited to wetland wildlife habitat.

Representative profile of Seelyeville muck in an uncultivated area, 25 yards south and 150 yards east of center of NW¼, sec. 30, T. 31 N., R. 16 W.:

Oa1—0 to 4 inches; black (10YR 2/1) sapric material; about 10 percent fiber and a trace rubbed; moderate medium granular structure; friable; many roots; medium acid; abrupt smooth boundary.

Oa2—4 to 8 inches; black (N 2/0) sapric material; about 5 percent fiber and a trace rubbed; moderate coarse subangular blocky structure; friable; common roots; medium acid; clear smooth boundary.

Oa3—8 to 16 inches; black (N 2/0) sapric material; about 5 percent fiber and a trace rubbed; moderate medium subangular blocky structure that parts to moderate medium granular structure; friable; common roots; medium acid; clear smooth boundary.

Oa4—16 to 24 inches; black (N 2/0) sapric material; about 30 percent very fine fiber and a trace rubbed; moderate medium prismatic structure; friable; common roots in upper part of horizon; slightly acid; clear smooth boundary.

Oa5—24 to 45 inches; black (10YR 2/1) sapric material; about 10 percent fiber and only a trace rubbed; massive; nonsticky; slightly acid; clear smooth boundary.

Oa6—45 to 55 inches; black (10YR 2/1) sapric material; about 40 percent fiber, less than 10 percent rubbed; massive; nonsticky; slightly acid; gradual smooth boundary.

IIC—55 to 60 inches; black (10YR 2/1) medium and fine sand; loose; band of sedimentary peat about 2 inches thick, organic coatings on sand; neutral.

Seelyeville soils consist mainly of black sapric organic materials extending to a depth of more than 51 inches. Mineral or limnic material is at depth below 51 inches. Also, in many places, the sapric material contains layers less than 6 inches thick of brown or dark yellowish brown hemic or fibric material. Most of these soils are medium acid to slightly acid to a depth of 40 to 60 inches and are neutral below.

Seelyeville soils are near Fluvaquents, wet. They formed in organic material, whereas Fluvaquents, wet, typically formed in stratified silt and sand.

Sm—Seelyeville muck. This soil is in drainageways, on flood plains, and in depressions. Most areas are oblong or round in shape and range from 10 to 160 acres in size. Slopes are 0 to 2 percent.

Included with this soil in mapping are a few areas where the depth to sandy, loamy, or limnic material is less than 50 inches. Also included are a few areas of Fluvaquents, wet, and Saprists and Aquents.

This soil is in low areas where frost is commonly late in spring and early in fall. Depth to the seasonal

high water table is 0 to 1 foot. Runoff is slow or ponded. Many areas of this soil are frequently flooded for long periods, especially early in spring. Deep ditches and tile drains help lower the water table and remove excess water. In drained areas soil blowing is a hazard, and the soil is subject to subsidence.

Most areas of this soil are used for wildlife habitat. A few areas are used for pasture. Capability group IVw–9; woodland group 3w3.

Skyberg Series

The Skyberg series consists of nearly level and gently sloping, somewhat poorly drained soils on foot slopes and in drainageways of ground moraines. These soils formed in silty sediment and the underlying heavy loam or clay loam till. Native vegetation was mainly red maple, red oak, ash, and white pine. Unless these soils are drained, the subsoil is saturated with water throughout most of the year.

In a representative profile the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsurface layer is about 10 inches of grayish brown, mottled silt loam. The subsoil is about 14 inches of grayish brown, firm, mottled, heavy loam. The substratum, to a depth of about 60 inches, is grayish brown, firm, mottled, heavy loam.

Available water capacity is high, and permeability is moderately slow. Natural fertility is high. The organic matter content of the surface layer is moderate. Depth of the root zone is somewhat limited for most farm crops by a perched water table in the subsoil. Water is ponded in many places during wet seasons.

Most areas of these soils are cultivated or in pasture. The soils are frequently used to grow corn. A few areas are in woods.

Representative profile of Skyberg silt loam, 0 to 3 percent slopes, in a cultivated field, 220 yards north and 30 yards west of southeast corner of sec. 28, T. 29 N., R. 16 W.:

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate medium granular structure; friable; common roots; medium acid; abrupt smooth boundary.

A21—8 to 10 inches; grayish brown (10YR 5/2) silt loam; common fine and medium prominent yellowish brown (10YR 5/6) mottles; weak thin and medium platy structure; friable; common roots; strongly acid; clear wavy boundary.

A22—10 to 18 inches; grayish brown (10YR 5/2) silt loam; many medium prominent yellowish brown (10YR 5/6–5/8) mottles; moderate medium platy structure; friable; common roots; very strongly acid; clear wavy boundary.

IIB2tg—18 to 25 inches; grayish brown (10YR 5/2) heavy loam, high silt content; many coarse prominent yellowish brown (10YR 5/6–5/8) mottles; moderate coarse and medium subangular blocky structure; firm; thick patchy (10YR 3/2) very dark grayish brown clay films on faces of peds; few roots; about 5 percent coarse fragments by volume; very strongly acid; clear wavy boundary.

IIB3tg—25 to 32 inches; grayish brown (10YR 5/2) heavy loam; many coarse prominent yellowish brown (10YR 5/6–5/8) mottles; moderate coarse subangular blocky structure; firm; thick patchy clay films; about 5 percent coarse fragments by volume; few roots; very strongly acid; clear wavy boundary.

IIC—32 to 60 inches; grayish brown (10YR 5/2) heavy loam; many coarse prominent yellowish brown (10YR 5/6–5/8) mottles; massive; firm; few roots; about 5 percent coarse fragments by volume; slightly acid.

The solum ranges from 30 to 40 inches in thickness. The silty sediment ranges from 15 to 48 inches in thickness, but it is 15 to 30 inches thick in most places. The Ap horizon is very dark brown or very dark grayish brown. The A2 horizon is brown, grayish brown, or light brownish gray.

The B horizon is heavy silt loam, heavy loam, or clay loam in the upper part and heavy loam or clay loam in the lower part. In many places a stone or gravel line or band is in the B horizon. The C horizon is massive, firm, heavy loam or clay loam. The IIB or IIC horizons are 0 to 5 percent coarse fragments. The B horizon is very strongly acid to strongly acid, and the C horizon is slightly acid to neutral.

Skyberg soils are near Auburndale, Floyd, and Vlasaty soils. They are more poorly drained than Vlasaty soils. They have a thinner A horizon than Floyd soils. They are better drained and have less sand in their C horizon than Auburndale soils.

SrA—Skyberg silt loam, 0 to 3 percent slopes. This soil is on slightly concave foot slopes and drainageways of low ground moraines. Most areas are oblong or irregular in shape and range from 10 to 60 acres in size.

Included with this soil in mapping are small areas of Auburndale and Floyd soils. Also included are a few areas of soils that are underlain at a depth of 3 to 5 feet by silty clay weathered from shale or by heavy loam or clay loam weathered from kaolinite and a few areas where slopes are more than 3 percent.

Runoff is slow, and the hazard of erosion is slight. This soil is ponded or flooded in many places during wet seasons. In many places depth to a seasonal, high perched water table ranges from 1 to 3 feet. Shallow surface ditches, water diversions, and waterways help remove runoff water. Tile drains help lower the seasonal perched water table.

Most areas of this soil are cultivated and are frequently used for corn. Where excess water is removed, the soil is well suited to corn, oats, and hay. Capability unit IIw–2; woodland group 2o2.

Udifluvents

Ud—Udifluvents consist of nearly level, somewhat poorly drained and moderately well drained soils on flood plains along rivers and streams. Most areas are elongated in shape and range from 5 to 80 acres in size. Slopes are 0 to 2 percent. These soils formed in light and dark colored sandy sediment deposited by

flood waters. This sediment has been deposied too recently for distinct horizons to form. Native vegetation was mostly wetland grasses and sedges; some shrubs, such as alder and willow; and a few scattered trees such as elm. These soils have a seasonal high water table at a depth of 2 to 5 feet.

Included with Udifluvents in mapping are small areas of Fluvaquents, Fluvaquents, wet, and Saprists and Aquents, and Gotham, Hubbard, and Seelyeville soils.

Runoff is slow, and the hazard of erosion is slight. Available water capacity is low, and permeability is variable but is mostly rapid. Natural fertility and the organic matter content of the surface layer are low. Most areas of these soils are flooded frequently for brief periods, especially in spring. Fresh sandy sediment is deposited during each flood. Some places are dissected by streams, sloughs, and old stream channels. Streambank erosion is a hazard in some places.

Most areas of these soils are in trees and brush. A few areas are cultivated. These soils are suited to wildlife habitat. Capability unit VIIs-9; woodland group 3s1.

Vlasaty Series

The Vlasaty series consists of gently sloping and sloping, moderately well drained soils on low ridges and knolls of ground moraines. These soils formed in silty sediment and in the underlying clay loam till. Native vegetation was mainly sugar maple, red oak, and white pine. The lower part of the subsoil is saturated with water for long periods during the year.

In a representative profile the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsurface layer is about 3 inches of pale brown silt loam. The subsoil is about 31 inches thick. In the upper part it is dark yellowish brown, friable, heavy silt loam, and in the lower part it is brown and dark grayish brown, very firm, mottled clay loam. The substratum, to a depth of 60 inches, is olive brown, very firm, mottled, clay loam.

Available water capacity is high, and permeability is moderately slow. Natural fertility is high. The organic matter content of the surface layer is moderate. Tillage is delayed for relatively long periods in spring and after heavy rain.

Most areas of this soil are cultivated. The soils are used to grow corn, oats, and alfalfa.

Representative profile of Vlasaty silt loam, 2 to 6 percent slopes, in a cultivated area, 200 yards east and 75 yards north of center of SE¼, sec. 23, T. 28 N., R. 16 W.:

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, light brownish gray (10YR 6/2) dry; weak fine subangular blocky structure parting to weak fine granular; friable; common roots; neutral; abrupt smooth boundary.

A2—8 to 11 inches; pale brown (10YR 6/3) silt loam; moderate medium and thick platy structure; very friable; common roots; medium acid; abrupt irregular boundary.

B&A—11 to 16 inches; dark yellowish brown (10YR 4/4) heavy silt loam (B2t); moderate medium subangular blocky structure; friable; interfingerings and a few tongues of pale brown (10YR 6/3) silt loam (A2); friable; very strongly acid; common roots; clear wavy boundary.

IIB21t—16 to 25 inches; brown (10YR 5/3) clay loam; few fine distinct yellowish brown (10YR 5/6) and faint grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; very firm; few thin pale brown (10YR 6/3) silt and fine sand coatings on ped faces; common thin dark brown (10YR 3/3) clay films on faces of peds; cobbly and gravelly band; common roots; very strongly acid; clear wavy boundary.

IIB22t—25 to 30 inches; dark grayish brown (10YR 4/2) clay loam; common medium prominent yellowish brown (10YR 5/6) mottles; moderate medium subangular band; common roots; very strongly acid; blocky structure; very firm; thick nearly continuous dark brown (10YR 3/3) clay films on faces of peds; about 5 percent coarse fragments by volume; few roots; very strongly acid; clear wavy boundary.

IIB23t—30 to 42 inches; brown (10YR 5/3) clay loam; many coarse prominent yellowish brown (10YR 5/6) and few fine distinct dark grayish brown (10YR 4/2) mottles; moderate coarse medium prismatic structure parting to moderate coarse subangular blocky; very firm; about 5 percent coarse fragments by volume; very strongly acid; few roots; clear wavy boundary.

IIC—42 to 60 inches; olive brown (2.5Y 4/4) clay loam; many medium and coarse prominent yellowish brown (10YR 5/6) grayish brown (10YR 5/2) and light brownish gray (10YR 6/2) mottles; massive; very firm; about 5 percent coarse fragments by volume; moderately alkaline.

The solum ranges from 40 to 50 inches in thickness. The silty mantle is 12 to 24 inches thick. The Ap horizon is very dark grayish brown or dark grayish brown and 6 to 10 inches thick.

The B horizon is clay loam or heavy loam. Thin, gravelly and cobbly bands or stone lines are commonly in the B horizon. The C horizon is heavy loam or clay loam. The B and C horizons are 0 to 5 percent coarse fragments. The B horizon is strongly acid to very strongly acid, and the C horizon is mildly alkaline to moderately alkaline.

Vlasaty soils are near Clyde and Skyberg soils. They are better drained than the somewhat poorly drained Skyberg soils. They have a thinner, lighter colored A horizon and are better drained than the poorly drained Clyde soils.

VaB—Vlasaty silt loam, 2 to 6 percent slopes. This soil is on low ridges of ground moraines. Most areas are oblong or irregular in shape and range from 5 to 100 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are some areas

where the surface layer is sandy loam. Also included are a few areas of moderately well drained soils that have a gray subsoil and a few small areas of Clyde, Floyd, and Skyberg soils. Also, in some areas near Arland soils, Vlasaty soils are underlain by sand at a depth of slightly more than 4 feet.

Runoff is slow, and the hazard of erosion is slight. Tillage is delayed because this soil remains saturated for relatively long periods in spring and after heavy rains.

This soil is well suited to corn, oats, and alfalfa. It is frequently used for corn. Controlling erosion, especially on long slopes, is an important factor of good management. Capability unit IIe–1; woodland group 2o1.

VaC2—Vlasaty silt loam, 6 to 12 percent slopes, eroded. This soil is on low ridges and knolls of ground moraines. Most areas are oblong or irregular in shape and range from 5 to 30 acres in size.

This soil has a profile similar to the one described as representative of the series, but the surface layer is thinner and lighter colored.

Included with this soil in mapping are a few small areas where the surface layer is sandy loam. Also included are a few small areas of Clay, Floyd, and Skyberg soils and a few small areas where slopes are slightly less than 6 percent or more than 12 percent. In a few areas near Arland soils, Vlasaty soils are underlain by sand at a depth of slightly more than 4 feet.

Runoff is medium, and the hazard of erosion is moderate. Tillage is delayed because this soil remains saturated for relatively long periods in spring and after heavy rains. In most places, erosion has caused tilth to deteriorate and has reduced the content of organic matter in the surface layer.

This soil is well suited to oats and alfalfa, and is suited to a limited amount of corn. Controlling erosion and maintaining tilth are important factors of good management. Capability unit IIIe–1; woodland group 2o1.

Whalan Series

The Whalan series consists of gently sloping to steep, well drained soils on ridges, valleys, and knolls of limestone uplands that are covered by a thin mantle of glacial till. These soils formed in silty sediment, loamy glacial till, and clayey dolomitic limestone residuum. They are underlain by dolomitic limestone. Native vegetation was sugar maple, red oak, basswood, and elm.

In a representative profile the surface layer is dark grayish brown silt loam about 8 inches thick. The subsoil is about 26 inches thick. It is dark brown, friable silt loam in the upper part; yellowish red, firm loam in the middle part; and reddish brown, firm clay loam in the lower part. Fractured dolomitic limestone bedrock is at a depth of about 34 inches.

Available water capacity is moderate, and permeability is moderate in the upper part and moderately slow in the clay loam dolomitic limestone residuum. Natural fertility is medium. The organic matter content of the surface layer is moderate.

Most gently sloping and sloping soils are used to grow corn, oats, alfalfa, and other crops commonly grown in the county. Most steeper soils are used for hay and pasture and some are in woods.

Representative profile of Whalan silt loam, 2 to 6 percent slopes, in a cultivated area, 200 yards south and 200 yards east of center of sec. 16, T. 28 N., R. 19 W.:

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam; weak fine and very fine subangular blocky structure; friable; common roots; slightly acid; abrupt smooth boundary.

B1—8 to 12 inches; dark brown (7.5YR 4/4) silt loam; moderate medium subangular blocky structure; friable; common roots; medium acid; clear wavy boundary.

B21t—12 to 16 inches; dark brown (7.5YR 4/4) silt loam; moderate medium subangular blocky structure; friable; thin patchy clay films; common roots; medium acid; clear wavy boundary.

B22t—16 to 20 inches; dark brown (7.5YR 4/4) gritty silt loam; moderate medium subangular blocky structure; friable; thin patchy clay films; common roots; strongly acid; clear wavy boundary.

IIB23t—20 to 30 inches; yellowish red (5YR 4/6) loam; strong coarse subangular blocky structure; firm; thin patchy reddish brown (5YR 4/4) clay films; about 15 percent coarse fragments by volume; few roots; very strongly acid; abrupt wavy boundary.

IIIB3t—30 to 34 inches; reddish brown (5YR 4/4) clay loam; strong medium subangular blocky structure; firm, plastic; thick nearly continuous dark reddish brown (5YR 3/3) clay films and yellowish red (5YR 4/8) coatings of silt grains; few roots; medium acid; abrupt smooth boundary.

IIIR—34 inches; very pale brown (10YR 8/3) fragmented dolomitic limestone bedrock.

The solum thickness and depth to limestone bedrock range from 20 to 40 inches. The silty mantle is 15 to 25 inches thick. The Ap horizon is dark grayish brown or very dark grayish brown and 6 to 10 inches thick.

The B horizon is sandy clay loam or clay loam in the lower part. The B horizon that formed in the till is 5 to 25 percent coarse fragments. The B horizon is medium acid to very strongly acid in the upper part and medium acid in the lower part.

Whalan soils are near Ritchey and Santiago soils. They are deeper to dolomitic bedrock than Ritchey soils. They formed in a thinner till deposit than Santiago soils.

WhB—Whalan silt loam, 2 to 6 percent slopes. This soil is on ridges of limestone uplands that are covered by a thin mantle of silty sediment and glacial till. Most areas are irregular in shape and range from 5 to 30 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are a few small areas of Ritchey, Rockton, and Santiago soils. Also included are a few small areas where the depth to limestone bedrock ranges from 40 to 60 inches and a few

areas where till in the lower part of the subsoil is not evident.

Runoff is slow, and the hazard of erosion is slight.

Most areas of this soil are used for crops. The soil is well suited to corn, oats, and alfalfa. The main concerns of management are controlling erosion and maintaining tilth and organic matter content. Capability unit IIe–2; woodland group 2o1.

WhC2—Whalan silt loam, 6 to 12 percent slopes, eroded. This soil is on narrow ridges and valleys of limestone uplands that are covered by a thin mantle of silty sediment and glacial till. Most areas are irregular in shape and range from 5 to 25 acres in size.

This soil has a profile similar to the one described as representative of the series, but the surface layer is thinner and lighter colored. As a result of erosion and plowing some of the subsoil has been mixed into the plow layer.

Included with this soil in mapping are a few small areas of Ritchey, Rockton, and Santiago soils. Also included are a few areas where the till in the lower part of the subsoil is not evident.

Runoff is medium, and the hazard of erosion is moderate.

Most areas of this soil are cropped. The soil is suited to oats, alfalfa, and a limited amount of corn. The main concerns of management are controlling erosion and maintaining tilth and soil structure. Capability unit IIIe–2; woodland group 2o1.

WhD2—Whalan silt loam, 12 to 25 percent slopes, eroded. This soil is on knolls and narrow ridges or valleys of limestone uplands that are covered by a thin mantle of silty sediment and glacial till. Most areas are irregular in shape and range from 5 to 20 acres in size.

This soil has a profile similar to the one described as representative of the series, but the surface layer is thinner and lighter colored and the subsoil is thinner.

Included with this soil in mapping are a few small areas of Ritchey soils and a few small areas where slopes are more than 25 percent.

Runoff is rapid, and the hazard of erosion is severe.

Most areas of this soil are used for pasture or hayland. A few areas are still in woodland. The soil is moderately well suited to alfalfa and grasses and poorly suited to row crops. Controlling erosion and maintaining soil tilth and structure are important factors of good management. Capability unit IVe–2; woodland group 2r1.

Use and Management of the Soils

This section contains information about the use and management of the soils of St. Croix County for crops and pasture, woodland, wildlife, recreation, and engineering. It explains the system of capability classification used by the Soil Conservation Service and gives predicted yields of the principal crops grown in the county under a high level of management.

This section also groups the soils according to their suitability for woodland and wildlife habitat. It contains tables that give ratings of the soils for farm and nonfarm uses and for recreation, and it contains information about soils that is significant in engineering.

Management for Crops and Pasture

About 90 percent of the land area in St. Croix County is used for crops and pasture. Corn, oats, and hay are the main crops grown and are the basis for a livestock and dairy industry. Some cash crops such as soybeans, canning peas, kidney beans, and navy beans are also grown, especially in the western and central parts of the county. About two-thirds of the soils in St. Croix County have long slopes that are less than 6 percent. These soils are susceptible to erosion where cultivated. Many of the soils in depressions and drainageways, especially in the south-central and southeastern parts of the county, are underlain by till of plastic, heavy loam or clay loam. These soils are wet and cold for long periods in spring. In the following paragraphs, basic practices for managing the soils for the commonly grown crops and pasture are discussed, the system of capability classification is explained, and the capability units are described. Finally, average yields are predicted for some of the principal crops under a high level of management in table 2.

Basic practices of management

The soils of St. Croix County vary in their suitability for specific crops, and they require widely different management. Some basic management practices are needed, however, for practically all of the soils. The following paragraphs describe basic practices needed for maintaining good soil structure, tilth, organic matter content, and fertility; providing drainage; and controlling erosion. Also, they describe renovation of pastures. These are basic practices to be used in managing the soils. Specific practices of management are suggested in the capability units. Technical assistance in planning and applying suitable practices for the soils on a particular farm can be obtained from a local representative of the Soil Conservation Service or the Extension Service.

Soil structure and tilth.—Soils having good structure and tilth take in and hold more available water than soils where tilth has been destroyed by tillage. Good tilth also helps decrease runoff and erosion. Good tilth and granular or fine subangular blocky structure provide a favorable seedbed. Such a seedbed absorbs moisture and favors vigorous germination and emergence of small seeded crops. Tilth in most soils in St. Croix County, especially those of the glacial uplands, has deteriorated because of tillage and erosion. Heavy manuring, more years of hay in the rotation of crops, and minimum tillage will help maintain soil tilth of cultivated soils.

Organic matter content.—The organic matter content of St. Croix County soils ranges from less than 1 percent to more than 20 percent. The well decomposed organic matter or humus in the soil has a great effect on the ability of a soil to hold plant nutrients. The organic matter content also influences the infiltration rate, tilth, and water-holding capacity of the surface layer. Many of the newer herbicides have suggested rates of application based on the organic matter content of the surface layer; where the rates have not been followed, crops were damaged or weeds flourished.

Applications of barnyard manure, plowing under green manure and crop residue, and more years of hay

TABLE 2.—*Predicted average yields per acre of the principal crops*

[These yields are those under an improved or high level of management. Absence of a yield figure indicates that the soil is not suited to the crop, or that the crop is not ordinarily grown on that soil]

Map symbol	Soil	Corn		Oats [1]	Alfalfa-brome hay [2] (dry weight)	Native bluegrass pasture
		Grain	Silage			
		Bu	*Tons*	*Bu*	*Tons*	*Aud* [3]
AdA	Adolph silt loam, 0 to 3 percent slopes [4]	70	12.0	60		100
AlB	Amery sandy loam, 2 to 6 percent slopes	70	12.0	50	2.75	70
AlC2	Amery sandy loam, 6 to 12 percent slopes, eroded	65	11.0	45	2.5	60
AlD2	Amery sandy loam, 12 to 25 percent slopes, eroded			35	2.0	60
AmB	Amery loam, 2 to 6 percent slopes	80	13.0	70	3.5	110
AmC2	Amery loam, 6 to 12 percent slopes, eroded	75	12.5	65	3.0	100
AmD2	Amery loam, 12 to 20 percent slopes, eroded	70	12.0	60	2.5	90
AmE2	Amery loam, 20 to 30 percent slopes, eroded				2.0	70
AnC2	Amery-Cromwell sandy loams, 6 to 12 percent slopes, eroded	60	10.0	45	2.0	40
AnD2	Amery-Cromwell sandy loams, 12 to 25 percent slopes, eroded				1.75	35
AoA	Antigo silt loam, 0 to 2 percent slopes	90	15.0	80	3.5	110
AoB	Antigo silt loam, 2 to 6 percent slopes	85	14.0	80	3.5	110
ApC2	Arland sandy loam, 6 to 12 percent slopes, eroded	65	11.0	45	2.25	60
ApD2	Arland sandy loam, 12 to 25 percent slopes, eroded	60	10.0	40	2.0	60
ApF	Arland sandy loam, 25 to 35 percent slopes			35	2.0	60
AsB	Arland silt loam, 2 to 6 percent slopes	80	13.0	65	3.5	90
AsC2	Arland silt loam, 6 to 12 percent slopes, eroded	75	12.5	60	3.0	80
AuA	Auburndale silt loam, 0 to 3 percent slopes [4]	70	12.0	60	3.5	100
BnB	Boone loamy fine sand, 2 to 6 percent slopes	40	7.0	35	2.0	30
BnC	Boone loamy fine sand, 6 to 12 percent slopes				1.5	30
BnD	Boone loamy fine sand, 12 to 20 percent slopes					30
BpA	Brill silt loam, 0 to 3 percent slopes	80	13.0	80	4.0	110
BrB	Burkhardt sandy loam, 1 to 6 percent slopes	60	10.0	45	2.5	70
BrC2	Burkhardt sandy loam, 6 to 12 percent slopes, eroded	55	9.0	40	2.0	60
BxB	Burkhardt-Sattre complex, 2 to 6 percent slopes	75	12.5	55	2.75	80
BxC2	Burkhardt-Sattre complex, 6 to 12 percent slopes, eroded	70	12.0	50	2.5	70
BxD2	Burkhardt-Sattre complex, 12 to 30 percent slopes, eroded				2.0	60
CoC2	Chetek-Onamia complex, 6 to 12 percent slopes, eroded	65	11.0	45	2.25	65
CoD2	Chetek-Onamia complex, 12 to 20 percent slopes, eroded				1.75	60
CoE	Chetek-Onamia complex, 20 to 30 percent slopes					50
CyA	Clyde silt loam, 0 to 3 percent slopes [4]	85	14.0	60		120
Cz	Cut and fill areas					
DaA	Dakota loam, 0 to 2 percent slopes	80	13.0	60	3.0	90
DaB	Dakota loam, 2 to 6 percent slopes	80	13.0	60	3.0	90
DcC2	Dakota-Pillot complex, 6 to 12 percent slopes, eroded	75	12.5	55	2.75	90
DeB	Derinda silt loam, 2 to 6 percent slopes	80	13.0	75	4.25	140
DeC2	Derinda silt loam, 6 to 12 percent slopes, eroded	75	12.5	70	4.0	130
DfB	Derinda Variant silt loam, 1 to 6 percent slopes [4]	80	13.0	70	3.5	140
DkB	Dickman sandy loam, 2 to 6 percent slopes	70	12.0	55	2.5	70
Du	Duelm loamy sand [4]	55	9.0	45	2.25	55
EmE	Emmert loamy sand, 12 to 35 percent slopes				1.55	25
FdA	Floyd silt loam, 0 to 3 percent slopes [4]	95	16.0	60	4.0	140
Fe	Fluvaquents [4]	60	10.0	60	3.0	100
Fm	Fluvaquents, wet					
FnB	Freeon silt loam, 2 to 6 percent slopes	80	13.0	75	3.75	140
FoB	Freeon silt loam, heavy substratum, 2 to 6 percent slopes	85	14.0	75	4.0	140
FoC2	Freeon silt loam, heavy substratum, 6 to 12 percent slopes, eroded	80	13.0	70	4.0	130
GoB	Gotham loamy fine sand, 2 to 6 percent slopes	60	10.0	50	2.5	30
GoC	Gotham loamy fine sand, 6 to 12 percent slopes	55	9.0	40	2.0	30
Gp	Gravel pits					
HaA	Halder silt loam, 0 to 3 percent slopes [4]	80	13.0	70	3.5	120
HeB	Hesch fine sandy loam, 2 to 6 percent slopes	80	13.0	60	3.0	90
HeC2	Hesch fine sandy loam, 6 to 12 percent slopes, eroded	75	12.5	55	2.5	80
HeD2	Hesch fine sandy loam, 12 to 20 percent slopes, eroded	65	11.0	50	2.0	70
HrB	Hubbard loamy sand, 0 to 6 percent slopes	45	7.5	35	2.0	30
HsB	Hubbard loamy sand, loamy substratum, 0 to 6 percent slopes	65	11.0	35	2.0	45
HsC	Hubbard loamy sand, loamy substratum, 6 to 12 percent slopes			35	2.0	45
HuA	Huntsville silt loam, 0 to 3 percent slopes [4]	115	19.0	70	4.5	140
JeA	Jewett silt loam, 0 to 2 percent slopes	95	16.0	75	4.0	140
JeB	Jewett silt loam, 2 to 6 percent slopes	90	15.0	75	4.0	140
JeC2	Jewett silt loam, 6 to 12 percent slopes, eroded	85	14.0	70	3.5	130
JsA	Jewett silt loam, sandy substratum, 0 to 2 percent slopes	90	15.0	65	3.5	110
JsB	Jewett silt loam, sandy substratum, 2 to 6 percent slopes	85	14.0	60	3.5	110
LcA	Lawler silt loam, 0 to 3 percent slopes [4]	100	16.5	65	3.5	120

TABLE 2.—*Predicted average yields per acre of the principal crops*—Continued

Map symbol	Soil	Corn		Oats [1]	Alfalfa-brome hay [2] (dry weight)	Native bluegrass pasture
		Grain	Silage			
		Bu	*Tons*	*Bu*	*Tons*	*Aud* [3]
MaB	Magnor silt loam, 1 to 6 percent slopes [4]	75	12.5	70	3.5	140
NcB	Nickin silt loam, 2 to 6 percent slopes	85	14.0	65	3.5	100
NcC2	Nickin silt loam, 6 to 12 percent slopes, eroded	80	13.0	60	3.0	90
NnD2	Nickin loam, 12 to 20 percent slopes, eroded	70	12.0	60	3.0	100
OmB	Onamia loam, 2 to 6 percent slopes	75	12.5	55	3.0	90
OmC2	Onamia loam, 6 to 12 percent slopes, eroded	70	12.0	50	2.5	80
OnC2	Onamia-Antigo complex, 6 to 12 percent slopes, eroded	75	12.5	55	2.5	90
OnD2	Onamia-Antigo complex, 12 to 25 percent slopes, eroded	65	11.0	50	2.0	80
OrA	Orion silt loam, 0 to 3 percent slopes [4]	100	14.5	60	3.5	140
OtB	Otterholt silt loam, 2 to 6 percent slopes	105	17.0	75	4.5	140
OtC	Otterholt silt loam, 6 to 12 percent slopes	100	16.0	70	4.0	130
OtD2	Otterholt silt loam, 12 to 20 percent slopes, eroded	85	14.0	65	3.5	120
PlA	Pillot silt loam, 0 to 3 percent slopes	95	16.0	65	3.5	110
PmB	Plainfield loamy sand, 2 to 6 percent slopes	45	7.5	35	2.25	30
PmC	Plainfield loamy sand, 6 to 12 percent slopes				2.0	30
PmD	Plainfield loamy sand, 12 to 20 percent slopes				1.75	30
PoB	Port Byron silt loam, 2 to 6 percent slopes	115	18.0	75	4.5	140
PoC	Port Byron silt loam, 6 to 12 percent slopes	105	16.0	70	4.0	130
PoD	Port Byron silt loam, 12 to 20 percent slopes	85	14.0	60	3.0	120
ReB	Renova silt loam, 2 to 6 percent slopes	90	15.0	80	4.5	140
ReC2	Renova silt loam, 6 to 12 percent slopes, eroded	85	14.0	75	4.0	130
RgC2	Renova Variant loam, 4 to 12 percent slopes, eroded	70	12.0	60	3.5	80
RgD2	Renova Variant loam, 12 to 20 percent slopes, eroded	60	10.0	55	3.0	70
RhA	Rib silt loam, 0 to 3 percent slopes [4]	75	12.5	65	3.5	120
RnB	Ritchey silt loam, 2 to 6 percent slopes	65	11.0	60	3.5	75
RnC2	Ritchey silt loam, 6 to 12 percent slopes, eroded	60	10.0	55	3.0	65
RnD2	Ritchey silt loam, 12 to 20 percent slopes, eroded				3.25	65
RoE	Ritchey soils and Rock outcrop, 20 to 35 percent slopes					55
RpB	Rockton silt loam, 2 to 6 percent slopes	95	16.0	60	3.5	110
RpC2	Rockton silt loam, 6 to 12 percent slopes, eroded	85	14.0	60	3.5	100
RpD2	Rockton silt loam, 12 to 20 percent slopes, eroded	75	12.5	50	3.0	90
SaB	Santiago silt loam, 2 to 6 percent slopes	90	15.0	80	4.5	140
SaC2	Santiago silt loam, 6 to 12 percent slopes, eroded	85	14.0	75	4.0	130
ScC2	Santiago-Antigo complex, 6 to 12 percent slopes, eroded	80	13.0	70	3.5	110
ScD2	Santiago-Antigo complex, 12 to 25 percent slopes, eroded	70	12.0	65	2.5	100
Se	Saprists and Aquents					
ShA	Sattre loam, 0 to 2 percent slopes	75	12.5	60	3.0	90
ShB	Sattre loam, 2 to 6 percent slopes	75	12.5	55	3.0	90
ShC2	Sattre loam, 6 to 12 percent slopes, eroded	70	12.0	50	2.5	80
SlA	Sattre silt loam, 0 to 2 percent slopes	90	15.0	65	3.5	110
SlB	Sattre silt loam, 2 to 6 percent slopes	85	14.0	60	3.5	110
Sm	Seelyeville muck [4]		12.0			85
SrA	Skyberg silt loam, 0 to 3 percent slopes [4]	85	14.0	70	4.0	140
Ud	Udifluvents					25
VaB	Vlasaty silt loam, 2 to 6 percent slopes	95	16.0	75	4.0	140
VaC2	Vlasaty silt loam, 6 to 12 percent slopes, eroded	90	15.0	70	3.5	130
WhB	Whalan silt loam, 2 to 6 percent slopes	85	14.0	70	3.5	110
WhC2	Whalan silt loam, 6 to 12 percent slopes, eroded	80	13.0	60	3.25	100
WhD2	Whalan silt loam, 12 to 25 percent slopes, eroded	70	12.0	50	3.0	90

[1] Yields are for oats seeded with a grass legume mixture. Higher yields may be obtained, but a poorer stand of legume-grass seeding usually results.

[2] Yields are for hay cut from first or second years after the stand is adequately established.

[3] Animal-unit-day: the amount of forage or feed required to maintain one cow, one horse, one mule, five sheep, or five goats for one day.

[4] Yields are for areas of this soil that are protected from flooding or ponding.

in the cropping system help maintain or increase the organic matter content of the soil. Most cultivated soils in St. Croix County need additional organic matter. Additional organic matter is especially beneficial to sandy soils, where it helps increase the available water capacity and natural fertility. On upland soils additional organic matter increases the water intake and decreases runoff and erosion.

The general level of organic matter is listed for each soil series in the section "Description of the Soils." The amounts in each class are given in the Glossary.

Maintaining Fertility.—Fertility can be maintained or increased by using a cropping system that provides for regular additions of organic matter and commercial fertilizers to the soils. The amount and kind of commercial fertilizer to apply depends on the supply of plant

nutrients in the soil, the ability of the soil to hold nutrients, the available water capacity, the kinds of crops to be grown, and the crop rotation. Where the need for lime and fertilizer is indicated in the suggestions for management, the amount of lime and the kind and amount of fertilizer to apply should be determined by soil tests. An indirect benefit from a higher level of fertility is the production of more plant litter and organic matter, which reduces erosion and promotes good soil tilth. Usually, heavy applications of lime and potassium are needed to grow alfalfa hay and pasture. Changes in soil acidity affect the availability of plant nutrients. Phosphorus and nitrogen are more readily available to plants if the soil reaction is near neutral. Generally, less lime is required to neutralize such sandy soils as Gotham and Plainfield soils than is required to neutralize silty or clayey soils; but the lime is leached out more quickly from sandy soils, so more frequent applications of lime are necessary.

Rating of the available water capacity is given to a depth of 5 feet or to bedrock in the capability unit descriptions. These ratings are defined in the Glossary and are also listed for each series in the section "Descriptions of the Soils."

As an example, assuming that alfalfa and corn require 0.30 inch of water per day during their peak use period, the number of days that a given soil will support these crops without rainfall can be determined. Thus, the soils that have a high available water capacity, between 9 and 12 inches, will support these crops for 30 to 40 days without rain, if the moisture content of the soils is at field capacity at the beginning of this period. In contrast, soils that have a low available water capacity, between 3 and 6 inches, will support these crops for only 10 to 20 days without rain under similar conditions.

The available water capacity is very important in determining levels of fertilization and population of plants where no irrigation is planned. A high level of fertilization is generally not justified on soils that have very low or low available water capacity, because crop growth is limited by the available water capacity. In addition, the soils that have very low and low available water capacity are coarse textured or have a thin solum. Excessive amounts of nitrate fertilizer added to these soils may be quickly leached from the soil and contaminate surface or ground water.

Providing drainage.—Drainage can be improved in most of the wet soils in the county if there are suitable outlets. Draining a wet soil makes it more favorable for growth of upland plants and increasing soil organisms, which improve the subsoil structure. Furthermore, damage to plant roots, particularly of alfalfa and sweet clover, by alternate freezing and thawing is reduced. Drainage also increases the root zone by lowering the seasonal high water table. Thus, more nutrients are available to plants. A soil warms earlier in spring if excess water is drained away because evaporation at the surface is reduced and less heat is needed to warm the soil. Soils that are inadequately drained are likely to be 5 to 15 degrees cooler in the spring than well drained soils.

Surface drains, tile drains, open-ditch drains, or a combination of these are used to provide drainage. Diversions can be used in some places to protect soils from runoff from adjacent areas. Soils on flood plains need protection from flooding.

Adolph, Halder, Lawler, Orion, and Rib soils respond well to both surface and tile drainage. Duelm soils generally are not suited to tile drainage unless precautions are taken to keep sand from entering the tile lines. These soils respond well to surface and open-ditch drainage. There is a danger of over-draining sandy soils such as those of the Duelm series, resulting in a droughty condition. Organic soils such as those of the Seelyeville series respond well to both tile and open-ditch drainage, but there is a danger of frost damage to crops grown on this soil.

When organic soils are drained there are several hazards. One of these is subsidence. Subsidence is the loss of surface elevation and is approximately ½ to 1 inch per year in Wisconsin. The subsidence potential is high for Seelyeville soils.

Subsidence of organic soils after drainage is attributed mainly to four factors: loss of buoyancy caused by ground water, consolidation, compaction, and biochemical activity. Elevation loss caused by the first three factors is initial subsidence and is normally accomplished in about three years after the water table is lowered. Initial subsidence of organic soils typically results in a one-half reduction in thickness of the organic materials above the water table.

After initial subsidence, shrinkage continues at a fairly uniform rate because of biochemical oxidation of the organic materials. This is termed continued subsidence and progresses until mineral material or the water table is reached. The rate of continued subsidence depends on the depth to the water table and increases as depth increases. Subsidence of organic soils can be stopped by maintaining the water level at the surface. It can be slowed by maintaining the water level as high as possible for the land use.

Controlling erosion.—Many of the soils in the county are moderately eroded. Examples are sloping and moderately steep Amery and Santiago soils. Most of the soil lost by erosion is the result of sheet and rill erosion, although some gullying also occurs.

Practices that help to control erosion are terracing, using water diversions and grassed waterways, stripcropping, contour tilling, growing sod crops or cover crops in rotations, and mulching with crop residue.

Grassed waterways provide a sod cover in natural drainageways and allow water to flow down slopes with little or no erosion. Generally, the waterway has to be shaped to proper dimensions, seeded or sodded with suitable grass, and fertilized. Grass height must be controlled by mowing or grazing. Waterways should not be used for roadways or livestock lanes. Gullies are formed where excessive erosion occurs in drainageways. Further gullying is usually arrested by gully stabilization structures such as toewalls, earthen dams, and water diversions. Earthen dams are also used for flood control or for creating multiple use ponds.

In St. Croix County, water diversions and terraces are important soil and water conservation practices. Much of the tilled land consists of gently sloping or sloping soils that have long slopes well suited to terracing. Most soils in the glacial uplands in the south-central and southeastern parts of the county are underlain by heavy loam or clay loam till that has

moderately slow or slow permeability. These soils are more susceptible to ponding and erosion than other glaciated areas of the county. Water diversions and terraces are used on these soils to shorten slopes and to reduce erosion by intercepting surface runoff and channeling it to a stable outlet.

Using close-growing crops such as small grains and alfalfa-grass hay in a crop rotation helps decrease soil erosion. A sod cover helps reduce raindrop impact, slows runoff, and helps increase infiltration of water.

Most soils that are suitable for terracing are also suitable for contour stripcropping. Stripcropping consists of plowing, planting, and tilling at a constant elevation along the slope. The objective is to hold the water where it falls, increase water intake, and decrease runoff and soil erosion. For contour stripcropping to be most effective, a suitable cropping system is used in which hay crops are grown in alternate strips with row crops or small grain. The strips of hay slow down and spread out any surface water flowing down slope. The gently sloping soils in St. Croix County that have a wetness problem are not suited to stripcropping because the strips decrease the runoff and increase the wetness.

Another practice which is very effective in controlling water erosion is minimum tillage. This practice reduces soil erosion in row crops to a minimum. In the latest refinement of this practice, a minimum area of soil is disturbed. Special "no-till" planters knife open the seedbed, place the seed and starter fertilizer, close the seedbed, and apply a herbicide all in one operation. The use of the proper kind and amount of herbicide is very important in minimum tillage. If the herbicide does not control the weeds they will have to be controlled by cultivation, thus reducing the effectiveness of the original minimum tillage operation.

Some of the soils in the county are subject to soil blowing, another type of erosion. Soil blowing is especially evident in droughty soils that have a sandy surface layer, such as Boone, Gotham, Hubbard, and Plainfield soils. In places it is also evident in drained areas of such organic soils and wet sandy soils as Seelyeville and Duelm soils. Practices that help to control soil blowing are stripcropping at right angles to the direction of prevailing winds, stubble mulching, leaving crop residue on the surface, growing cover crops or meadow crops, establishing shelterbelts, and controlling drainage in organic soils and wet sandy soils. Many of these practices also help to catch snow and add moisture to the soil.

Renovating pastures.—Most upland pastures on well drained soils of capability classes II, III, IV, and VI need renovating. A good seedbed is prepared and a suitable mixture of grasses and legumes is seeded. Examples of suitable mixtures for seeding are alfalfa with bromegrass or birdsfoot trefoil with bromegrass.

Large amounts of phosphorus and potassium are needed at the time of seeding. Nitrogen should be applied as a topdressing, especially if grasses are dominant. Applying fertilizer annually or renovating permanent pasture every five years helps to maintain good quality of the forage. Rotation of grazing protects and extends the life of the forage plants.

In St. Croix County the soils in capability class V have a high water table and are subject to flooding or seepage. Tillage is generally not practical, and renovation is not feasible. Such soils are generally kept in Kentucky bluegrass, reed canarygrass, or bromegrass. These soils should be grazed only in dry seasons; hummocks, which hinder surface drainage, develop if the soil is grazed when wet.

Pastures on soils of class VI are difficult to renovate, and soils of class VII are generally not suitable for renovation. Where tillage is not practical, these soils are generally kept in native vegetation. Control of grazing and addition of commercial fertilizer are ways to maintain plant cover.

Capability grouping

Some readers, particularly those who farm on a large scale, may find it practical to use and manage alike some of the different kinds of soil on their farm. These readers can make good use of the capability classification system, a grouping that shows, in a general way, the suitability of soils for most kinds of farming (*29*).

The grouping is based on permanent limitations of soils when used for field crops, the risk of damage when they are farmed, and the way the soils respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticultural crops, or other crops that require special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations for woodland or for engineering.

In the capability system, all kinds of soil are grouped at three levels: the capability class, the subclass, and the unit. The broadest grouping, the capability class, is designated by Roman numerals I through VIII. In class I are the soils that have the fewest limitations, the widest range of use, and the least risk of damage when they are used. The soils in the other classes have progressively greater natural limitations. In class VIII are soils and land forms so rough, shallow, or otherwise limited that they do not produce worthwhile yields of crops, forage, or wood products.

The capability subclass indicates major kinds of limitations within the classes. Within most of the classes there can be as many as 4 subclasses. The subclasses are indicated by adding a small letter, *e*, *w*, *s* or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* means that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c* indicates that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few or no limitations. Class V can contain, at the most, only subclasses *w*, *s*, and *c*, because the soils are subject to little or no erosion but have other limitations that confine their use largely to pasture or wildlife.

Subclasses are further divided into groups called capability units. These are groups of soils that are so much alike that they are suited to the same crops and pasture plants, they require about the same management, and have generally similar productivity and other response to management. Capability units are generally identified by numbers assigned locally, for example, IIe–1 or IIIs–4.

The eight classes in the capability system and the subclasses and units in St. Croix County are described in the following section. The unit designation is given in the Guide to Mapping Units.

Management by capability units

In the following paragraphs, the capability units in St. Croix County are described and suggestions for use and management of the soils in each unit are given. The capability units are not numbered consecutively, because not all of the units used in Wisconsin are in this county. To find the names of all the soils in any given capability unit, refer to the "Guide to Mapping Units" at the back of this survey.

CAPABILITY UNIT I–4

Jewett silt loam, 0 to 2 percent slopes, is the only soil in this unit. It is a well drained, loamy soil that is underlain by sandy loam till.

Permeability is moderate, and available water capacity is high. Because the water table is deep, this soil is not saturated with water for periods long enough to adversely affect plant growth. Natural fertility is high. Runoff is very slow, and the hazard of erosion is slight.

A cropping system that includes minimum tillage, good management of crop residue, and plowing under animal and green manure helps maintain soil structure, tilth, organic matter content, and fertility. The soil responds well to proper applications of fertilizer.

This soil is well suited to corn, soybeans, small grain, and legumes. It is frequently used for such row crops as corn and soybeans.

CAPABILITY UNIT IIe–1

This unit consists of gently sloping soils that are well drained or moderately well drained. These are loamy soils that are underlain by sandy loam to clay loam glacial drift.

Permeability is moderate or moderately slow. Available water capacity is high or very high in most soils of the unit but it is moderate in a few soils that have a surface layer of loam. Natural fertility is medium or high. In most soils of this unit the water table is deep, but in a few soils the lower part of the subsoil is saturated with water for long periods during the year. This delays tillage early in spring and after heavy rains. Runoff is slow, and the hazard of erosion is slight.

Such conservation practices as crop rotations, stripcropping, terraces, grassed waterways, minimum tillage, good management of crop residue, and manuring help control erosion and maintain soil structure, tilth, and fertility. The soils respond well to proper applications of fertilizer.

These soils are well suited to corn, soybeans, small grain, and legumes.

CAPABILITY UNIT IIe–2

This unit consists of gently sloping soils that are well drained. These are silty and loamy soils that are underlain by sand, sand and gravel, or bedrock.

Permeability is moderate in the subsoil and ranges from moderately slow to rapid in the substratum. Available water capacity is moderate in most soils of the unit, but it is low in a few soils that have a surface layer of loam. Natural fertility is medium. The water table is deep, so these soils are not saturated with water for periods long enough to adversely affect plant growth. Runoff is slow, and the hazard of erosion is slight.

The moderate available water capacity of soils in this unit restricts plant growth and slightly lowers crop yields during most growing seasons. Such conservation practices as crop rotations, stripcropping, terraces, grassed waterways, minimum tillage, good management of crop residue, and manuring help control erosion and maintain soil structure, tilth, and fertility. The soils respond well to proper applications of fertilizer. Irrigation may be feasible where special or high value crops are grown.

These soils are moderately well suited to corn, soybeans, small grain, and legumes. They are well suited to pasture.

CAPABILITY UNIT IIe–6

Derinda silt loam, 2 to 6 percent slopes, is the only soil in this unit. It is a moderately well drained soil that is underlain by silty clay weathered from shale.

Permeability is slow, and available water capacity is moderate. Water ponds on this soil in spring and after heavy rain. This Derinda soil has a subsoil saturated with water for long enough periods to adversely affect tillage. Natural fertility is medium. Maintaining soil structure and tilth of cultivated areas is difficult. The rooting zone is limited for most crops by the firm, clayey subsoil. Runoff is slow, and the hazard of erosion is slight.

Diversions and grassed waterways can be used to intercept and safely remove runoff water. Surface drainage can be used to remove some of the surface water and help prevent ponding. Cultivating at the proper moisture content, mainimum tillage, manuring, and good management of crop residue help maintain soil structure, tilth, and fertility.

If properly managed, this soil is moderately well suited to corn, small grain, and alfalfa. It is also well suited to pasture.

CAPABILITY UNIT IIw–1

Clyde silt loam, 0 to 3 percent slopes, is the only soil in this unit. It is a poorly drained and very poorly drained, loamy soil that is underlain by massive, heavy loam till.

Permeability is moderately slow, and available water capacity is high. This soil receives runoff from adjoining areas, and water ponds on it in spring and after heavy rains. A perched water table is at or near the surface throughout most of the year unless the soil is drained. Natural fertility is high. Runoff is very slow or slow, and the hazard of erosion is slight. Tile drains can be used to help lower the perched water table if a suitable outlet is available. Diversions and surface

drainage can be used to remove surface water and prevent ponding.

Where drained and protected from flooding, this soil is moderately well suited to corn, small grain, and other crops. If properly drained and fertilized, and if minimum tillage is used to return crop residue, row crops can be grown year after year without soil tilth deteriorating and without organic matter content seriously decreasing. Undrained areas are unsuited to row crops and alfalfa but are suited to wetland pasture and hardwoods.

CAPABILITY UNIT IIw–2

This unit consists of nearly level and gently sloping soils that are somewhat poorly drained. These are loamy soils that are underlain by massive, heavy loam till.

Permeability is moderately slow, and available water capacity is high. The subsoil of these soils is saturated with water throughout most of the year. These soils receive runoff from adjacent uplands, and water ponds in some areas in spring and after heavy rains. Natural fertility is high. Runoff is very slow or slow, and the hazard of erosion is slight.

Undrained areas of these soils can be used for crops, but wetness often delays planting and restricts plant growth. Maintaining tilth and soil structure is difficult. In undrained areas, the root zone is somewhat limited for most farm crops. Grassed waterways, diversions, and tile drainage help remove excess water and benefit crop growth. Cultivating at proper moisture content, minimum tillage, manuring, and good crop residue management help maintain tilth and soil structure.

Where adequately drained, these soils are well suited to corn, small grain, legumes, and most other crops. Undrained areas are generally used for corn, pasture, and hardwood trees. They are also moderately well suited to pasture.

CAPABILITY UNIT IIw–3

Derinda Variant silt loam, 1 to 6 percent slopes, is the only soil in this unit. It is a somewhat poorly drained soil that is underlain by silty clay weathered from shale.

Permeability is slow, and available water capacity is moderate. The subsoil is saturated with water throughout most of the year. This soil receives runoff from adjacent areas, and water ponds on it in some areas in spring and after heavy rains. Natural fertility is medium. Runoff is very slow or slow, and the hazard of erosion is slight. The zone of root penetration is shallow in this soil because of the firm, mostly clayey, subsoil that is wet in the lower part.

Undrained areas of this soil can be used for crops, but wetness in spring and after heavy rain often delays tillage and plant growth. Maintaining tilth and soil structure is difficult in undrained, cultivated areas. Use of tile drainage is not feasible in most places because this soil has slow permeability. Draining is difficult, but diversions and surface drains help remove excess water and benefit crop growth. Cultivation at proper moisture content, minimum tillage, manuring, and good crop residue management help maintain good tilth and soil structure. Even in drained areas, winterkill is a severe hazard to stands of alfalfa because the subsoil has a high frost action potential.

Where adequately drained, this soil is moderately well suited to corn, small grain, and alfalfa. Undrained areas are suited to pasture but are occasionally used for corn and other row crops.

CAPABILITY UNIT IIw–4

Magnor silt loam, 1 to 6 percent slopes, is the only soil in this unit. It is a somewhat poorly drained, loamy soil that is underlain by sandy loam glacial till.

Permeability is moderately slow, and available water capacity is high. The subsoil is saturated with water throughout most of the year. This soil receives runoff from adjacent uplands, and water ponds on it in some areas in spring and after heavy rains. Natural fertility is medium. Runoff is slow or very slow, and the hazard of erosion is slight.

Undrained areas of this soil can be used for crops, but wetness often delays tillage and restricts plant growth. Maintaining tilth and soil structure is difficult in undrained, cultivated areas. The rooting zone is somewhat limited for most farm crops by a wet subsoil. Water diversions and grass waterways help remove runoff from adjoining areas. Surface drainage can be used to remove surface water and prevent ponding. Where tile drainage is used, precautions should be taken to prevent sand from entering and clogging tile lines. Cultivating at the proper moisture content, minimum tillage, manuring, and good crop residue management help maintain good tilth and soil structure.

Where adequately drained, this soil is moderately well suited to corn, small grain, legumes, and most other crops. Undrained areas are well suited to pasture and hardwood trees, but occasionally they are used for corn and other row crops.

CAPABILITY UNIT IIw–5

This unit consists of nearly level and gently sloping soils that are somewhat poorly drained and poorly drained. These are loamy soils that are underlain by sand or sand and gravel.

Permeability ranges from moderate in the subsoil to rapid in the substratum. Available water capacity is moderate. In some soils in this unit, ground water is at or near the surface throughout most of the year unless drained. In others, part of the subsoil is saturated with water throughout most of the year unless drained. All soils in this unit receive runoff from adjoining areas, and some areas are subject to flooding and ponding in spring and after heavy rains. Natural fertility is medium. Runoff is very slow or slow, and the hazard of erosion is slight.

Maintaining tilth and soil structures is difficult in undrained, cultivated areas. Wet subsoil restricts root development of most farm crops. Grass waterways and water diversions help remove runoff water received from adjoining areas. Deep ditches can be used to lower the ground water if a suitable outlet is available. Using tile drainage is questionable, but if such drains are installed, precautions must be taken to prevent loose sand from entering and clogging tile lines. Surface drainage can be used to remove surface water and prevent ponding. Cultivation at the proper moisture content, minimum tillage, manuring, and good crop residue management help maintain good tilth and soil structure.

Areas of somewhat poorly drained soils can be used for limited crop production, but areas of poorly drained soils are not suited to crops unless they are drained. Where adequately drained, these soils are moderately well suited to corn, small grain, and hay crops. Undrained soils are well suited to pasture but are occasionally used for row crops.

CAPABILITY UNIT IIw–11

Huntsville silt loam, 0 to 3 percent slopes, is the only soil in this unit. It is a well drained and moderately well drained, silty soil.

Permeability is moderate, and available water capacity is very high. The lower part of this soil is saturated with water for relatively long periods throughout the year. This soil also receives runoff from adjacent areas and is flooded by stream overflow. Ponding and flooding delay tillage for short periods, especially early in spring and after heavy rains. Natural fertility is high. Runoff is very slow or slow. The hazard of erosion is slight in most places, but the soil is very susceptible to streambank and gully erosion, especially during periods of flooding.

Fencing cattle from streambanks, rock riprap along streambanks, grassed waterways, and maintaining a good sod cover help control erosion. Water diversions and grassed waterways help remove runoff received from adjoining areas. Surface drainage, water diversions, and dikes can be used to remove surface water and prevent ponding or flooding. Cultivating at the proper moisture content, minimum tillage, and good crop residue management help maintain good tilth and soil structure.

Where these soils are protected from flooding and streambank erosion, they are well suited to corn, soybeans, and other crops commonly grown. Unprotected areas of this soil are suited to pasture but are also occasionally used for row crops.

CAPABILITY UNIT IIw–13

This unit consists of nearly level and gently sloping soils that are moderately well drained and somewhat poorly drained. These are silty and loamy soils.

Permeability is moderate and moderately rapid. Available water capacity is mainly high and very high. Unless the soils of this unit are drained, part of the subsoil is saturated for long periods throughout most of the year. These soils receive runoff from adjacent upland areas and overflow from streams; this causes frequent ponding and occasional flooding. Natural fertility ranges from medium to high. Runoff is very slow or slow. Erosion is a slight hazard during most periods but streambank and gully erosion are severe hazards, especially during periods of flooding.

Undrained areas can be used for crop production, but wetness often delays tillage and restricts plant growth. Maintaining good tilth and soil structure is difficult in undrained, cultivated areas.

Grassed waterways and water diversions help remove runoff received from adjoining areas. Surface drainage, water diversions, and dikes can be used to remove surface water and prevent flooding or ponding. Deep ditches or tile drainage can be used to lower the seasonal high water table, but if tile drains are installed, precautions must be taken to prevent loose silt and sand from entering and clogging tile lines. Cultivation at proper moisture content, minimum tillage, and good crop residue management help maintain good tilth and soil structure.

Where these soils are drained and protected from flooding and streambank erosion, they are moderately well suited to corn and other crops commonly grown. Undrained areas are suited to pasture but are occasionally used for row crops.

CAPABILITY UNIT IIs–1

This unit consists of nearly level and gently sloping soils that are well drained. These are silty and loamy soils that are underlain by sand or sand and gravel.

Permeability is moderate in the subsoil and rapid in the substratum. Available water capacity is moderate in most soils but it is low in a few soils that have a surface layer of loam. Natural fertility is medium. Runoff is very slow or slow, and the hazard of erosion is slight. These soils are not saturated with water for periods long enough to adversely affect plant growth. The depth of the root zone is generally limited by sand and gravel.

These soils are slightly droughty. The response to fertilizer is limited by the moderate available water capacity. Such conservation practices as crop rotations, minimum tillage, manuring, and good management of crop residue help maintain good tilth, soil structure, and fertility. Irrigation may be feasible where vegetables or special crops are grown.

The soils in this unit are moderately well suited to corn, soybeans, small grain, legumes, and vegetable crops. They are also well suited to pasture.

CAPABILITY UNIT IIIe–1

This unit consists of sloping soils that are well drained and moderately well drained. These are loamy soils that are mostly underlain by sandy loam, loam or clay loam glacial drift.

Permeability is moderate or moderately slow. Available water capacity is high or very high in most soils, but it is moderate in a few soils that have a surface layer of loam or a sandy substratum. Natural fertility is medium or high. In most soils of this unit the water table is deep, but in a few soils the lower part of the subsoil is saturated for long periods early in spring and after heavy rains. Runoff is medium and the hazard of erosion is moderate. Many areas have lost as much as 4 inches of the original surface layer through erosion.

Such conservation practices as crop rotations, contour farming, stripcropping, diversions, terraces, grassed waterways, minimum tillage, manuring, and good management of crop residue help control erosion and maintain good tilth, soil structure, and fertility.

The soils of this unit are well suited to grasses, alfalfa, or trees. They are also suited to a limited amount of such row crops as corn, soybeans, and small grain.

CAPABILITY UNIT IIIe–2

This unit consists of sloping soils that are well drained and a few areas of gently sloping soils. These are loamy and silty soils that are underlain by soft sandstone, sand and gravel, or by limestone bedrock.

Permeability is moderate in the subsoil and ranges

from rapid to moderately slow in the substratum. Available water capacity is moderate in most soils but is low in a few areas where the soil has a surface layer of loam. Natural fertility is medium to high. The water table is deep, so the soils of this unit are not saturated with water for long enough periods to adversely affect plant growth. Generally, runoff is medium, and the hazard of erosion is moderate. Many areas have lost as much as 4 inches of the original surface layer through erosion.

These soils are slightly droughty and moderate available water capacity limits crop response to fertilizer during most growing seasons. Such conservation practices as crop rotations, contour farming, stripcropping, diversions, terraces, grassed waterways, minimum tillage, manuring, and good management of crop residue help control erosion and maintain good tilth, soil structure, and fertility.

These soils are well suited to grasses, alfalfa, and trees or pasture. They are also suited to a limited amount of such row crops as corn, soybeans, and small grain.

CAPABILITY UNIT IIIe-3

This unit consists of nearly level and gently sloping soils that are somewhat excessively drained and well drained. These loamy soils are underlain by sand and gravel or by limestone bedrock at a depth of less than about 20 inches.

Permeability is moderately rapid and moderate in the subsoil; permeability is rapid where the substratum is sand and gravel. Available water capacity is low in all soils in this unit except in a few areas where the soil is more than 20 inches thick over sand and gravel; in these areas available water capacity is moderate. Natural fertility is low or medium. The water table is deep, so the soils of this unit are not saturated with water for long enough periods to adversely affect plant growth. In Burkhardt soils the hazard of soil blowing is moderate. Runoff is very slow or slow, and the hazard of erosion is slight. Sand, gravel or limestone at a shallow depth restricts root development.

Such conservation practices as windbreak plantings, crop rotations, minimum tillage, manuring, and good management of crop residue help control soil blowing and maintain good soil tilth and structure. The low available water capacity restricts plant growth and severely lowers crop yields during the growing season. Crop response to fertilizer is significant, but it is limited for most soils in this unit by the low available water capacity. Crop yields are significantly increased, however, if the soils are irrigated and fertilized.

Soils in this unit are suited to corn, soybeans, small grain, legumes, and garden crops. Where irrigated and fertilized and where soil blowing is controlled, they are also well suited to row crops and special vegetable crops.

CAPABILITY UNIT IIIe-4

This unit consists of nearly level and gently sloping soils that are well drained and somewhat excessively drained. These are loamy and sandy soils that are underlain by sandy or loamy sediment.

Permeability ranges from moderate to rapid in the upper part of the soil and is moderate or moderately slow in the lower part of the soil. Available water capacity is moderate. Natural fertility is low or medium. The water table is deep, so the soils of this unit are not saturated with water for long enough periods to adversely affect plant growth. The hazard of soil blowing is moderate. Runoff is very slow or slow, and the hazard of erosion is slight.

These soils are slightly droughty, and the moderate available water capacity limits crop response to fertilizer during most growing seasons. Such conservation practices as crop rotations, windbreak plantings, minimum tillage, manuring, good management of crop residue, and grassed waterways help control erosion and maintain good tilth and soil structure. Irrigation may be feasible in some areas, especially where vegetable or special crops are grown.

If properly managed, the soils in this unit are moderately well suited to corn, soybeans, small grain, legumes, and garden crops. They are also well suited to pasture.

CAPABILITY UNIT IIIe-6

Derinda silt loam, 6 to 12 percent slopes, eroded, is the only soil in this unit. It is a moderately well drained soil that is underlain by silty clay weathered from shale.

Permeability is slow and runoff water ponds in depressions and along drainageways in spring and after heavy rains. Available water capacity is moderate. Natural fertility is medium. In this Derinda soil the subsoil is saturated with water for long enough periods to adversely affect tillage. Maintaining good tilth and soil structure is difficult. Root development is restricted by a firm, clayey subsoil. Runoff is rapid, and in most places the hazard of erosion is severe.

In spots on knolls and hillsides where the soil is eroded, tilth is poor and the soil is difficult to till because part of the clayey subsoil has been mixed into the plow layer. Such conservation practices as crop rotations consisting mainly of sod cover crops, grassed waterways, contour farming, stripcropping, diversions, minimum tillage, and good management of crop residue help control erosion and maintain good tilth and soil structure.

This soil is well suited to grasses, alfalfa, and pasture or trees. It is also suited to a limited amount of such row crops as corn, soybeans, and small grain.

CAPABILITY UNIT IIIe-7

This unit consists of sloping soils that are well drained. These are loamy soils that are underlain by sandy loam till or soft sandstone.

Permeability is moderate or moderately rapid, and available water capacity is low or moderate. Natural fertility is low to medium. The water table is deep, so soils of this unit are not saturated with water for long enough periods to adversely affect plant growth. Runoff is medium, and the hazard of erosion is moderate. Many areas have lost as much as 4 inches of the original surface layer through erosion.

The low and moderate available water capacity of the soils in this unit restricts plant growth and lowers crop yields during most growing seasons. Such conservation practices as crop rotations, contour farming, stripcropping, diversions, terraces, grassed waterways, minimum tillage, manuring, and good management of

crop residue help control erosion and maintain good tilth, soil structure, and fertility.

These soils are moderately well suited to grasses and alfalfa or pasture. They are also suited to a limited amount of such row crops as corn and soybeans.

CAPABILITY UNIT IIIw–3

Auburndale silt loam, 0 to 3 percent slopes, is the only soil in this unit. It is a poorly drained, silty soil that is underlain by sandy loam till.

Permeability is moderately slow, and available water capacity is high. This soil receives runoff from adjoining upland areas, and water ponds on it in spring and after heavy rains. Unless the soil is drained, a perched, high water table is at or near the surface throughout most of the year. Natural fertility is medium. Runoff is very slow or slow, and the hazard of erosion is slight.

Water diversions and grassed waterways help remove runoff water from adjoining areas. Surface drainage can be used to remove surface water and prevent ponding. Where a suitable outlet is available, tile drains can be used to lower the perched water table. Where tile drainage is used, precautions should be taken to prevent sand from entering and clogging tile lines. Cultivating at a proper moisture content, minimum tillage, manuring, and good crop residue management help maintain good tilth and soil structure.

Where adequately drained and protected from runoff and ponding, this soil is moderately well suited to corn, small grain, and other crops. If the soil is properly drained and fertilized and if minimum tillage is used to return crop residue, row crops can be grown year after year without seriously deteriorating soil tilth and without decreasing organic matter content. Undrained areas are suited to wetland pasture and hardwoods.

CAPABILITY UNIT IVe–1

This unit consists mainly of moderately steep soils that are well drained. They are silty or loamy soils that are underlain by sandy loam till, sand and gravel, silty sediment or soft sandstone.

Permeability is moderate. Available water capacity is high or very high in most soils but it is moderate in a few areas where the soil has a sandy substratum. Natural fertility is medium or high. These soils are not saturated with water for periods long enough to adversely affect plant growth. Runoff is rapid, and the hazard of erosion is severe. Some areas of these soils that have been cultivated have lost as much as 6 inches of the original surface layer through erosion.

These soils are difficult to till because of slope and because in eroded areas tilth is poor. Such conservation practices as crop rotations consisting mostly of sod cover crops, contour farming, stripcropping, diversions, grassed waterways, minimum tillage, and good management of residue help control erosion and maintain good tilth. The soils respond well to applications of fertilizer.

These soils are poorly suited to row crops. They are moderately well suited to a cropping system that consists mainly of alfalfa and grasses. A very limited amount of row crops is also grown. These soils are well suited to pasture or trees.

CAPABILITY UNIT IVe–2

This unit consists mainly of moderately steep soils that are well drained. They are loamy and silty soils that are underlain by soft sandstone, loamy sand, and sandy loam till, sand and gravel, or limestone.

Permeability is moderate in the subsoil and ranges from moderately slow to rapid in the substratum. Available water capacity is mainly moderate. The soils of this unit are not saturated with water for periods long enough to adversely affect plant growth. Natural fertility is medium. Runoff is rapid, and the hazard of erosion is severe. Some areas that have been cultivated have lost as much as 6 inches of the original surface layer through erosion.

These soils are difficult to till because of slopes and because of poor tilth in areas where they are eroded. Such conservation practices as crop rotations consisting mostly of sod cover crops, contour farming, stripcropping, grassed waterways, minimum tillage, and good management of crop residue help control erosion, increase infiltration, and maintain good tilth.

Soils in this unit are poorly suited to row crops. Very limited amounts of row crops are grown. These soils are moderately well suited to a cropping system that consists mainly of alfalfa and grasses. They are also moderately well suited to pasture and trees.

CAPABILITY UNIT IVe–3

This unit consists of sloping soils that are somewhat excessively drained and well drained. These are loamy soils that are underlain by sand and gravel or by limestone bedrock at a depth of generally less than 20 inches. Sand and gravel limestone at a shallow depth restricts root development and plant growth.

Permeability is moderate and moderately rapid in the subsoil and substratum but is rapid where the substratum is sand and gravel. Available water capacity is low in all soils in this unit except in a few areas where the soil is more than 20 inches thick over sand and gravel; in these areas available water capacity is moderate. Natural fertility is low or medium. The water table is deep, so the soils of this unit are not saturated with water for long enough periods to adversely affect plant growth. Soil blowing is a moderate hazard in most soils in this unit. Runoff is medium, and the hazard of erosion is moderate. Many of these soils have lost as much as 4 inches of the original surface layer through erosion.

The low available water capacity of most soils in this unit restricts plant growth and severely lowers crop yields during most growing seasons. Such conservation practices as crop rotations that consist mainly of sod cover crops, contour farming, stripcropping, grassed waterways, minimum tillage, manuring, and good management of crop residue help control erosion and maintain good tilth, soil structure, and fertility.

These soils are poorly suited to row crops, but if they are properly managed, they are suited to a cropping system that consists mainly of alfalfa and grasses. A limited amount of row crops is also grown. These soils are suited to pasture and are well suited to pine tree plantations.

CAPABILITY UNIT IVe–4

This unit consists of sloping soils that are somewhat

excessively drained and well drained. These are sandy soils that are underlain by loamy sediments or loamy soils that are underlain by sand in some places.

Permeability is mainly moderate but in many places it ranges from rapid to moderately slow as depth of the soil increases. The available water capacity is moderate in all soils in this unit except in a few areas where the soil has a sandy substratum; in these areas available water capacity is low. Natural fertility ranges from medium to low. The soils of this unit are not saturated with water for periods long enough to adversely affect plant growth. Soil blowing is a hazard on some soils. Runoff is slow or medium, and the hazard of erosion is slight or moderate. Many areas that have been cultivated have lost as much as 4 inches of the original surface layer through erosion.

Such conservation practices as crop rotations that consist mainly of sod cover crops, contour farming, stripcropping, grassed waterways, minimum tillage, and good management of crop residue help control erosion and maintain good tilth, soil structure, and fertility.

These soils are poorly suited to row crops, but if they are properly managed they are suited to a cropping system that consists mainly of alfalfa and grasses. A limited amount of small grain, corn, and other row crops is also grown. Soils in this unit are suited to pasture and trees.

CAPABILITY UNIT IVe-7

Arland sandy loam, 12 to 25 percent slopes, eroded, is the only soil in this unit. It is a well drained, loamy soil that is underlain mainly by soft sandstone.

Permeability is moderate, and available water capacity is low or moderate. Natural fertility is low or medium. The water table is deep, so the soil in this unit is not saturated with water for long enough periods to adversely affect plant growth. Runoff is rapid or very rapid, and the hazard of erosion is severe or very severe. Many areas have lost as much as 4 to 6 inches of the original surface layer through erosion.

The low and moderate available water capacity of these soils restricts plant growth and lowers crop yields during most growing seasons. Such conservation practices as crop rotations that consist mainly of sod cover crops, contour farming, stripcropping, grassed waterways, minimum tillage, manuring, and good management of crop residue help control erosion and maintain good tilth, soil structure, and fertility.

This soil is poorly suited to row crops. It is suited to pasture and trees. If it is properly managed, most soils in this unit are suited to a cropping system that consists mainly of alfalfa and grasses. A very limited amount of small grain and row crops is grown.

CAPABILITY UNIT IVw-3

Adolph silt loam, 0 to 3 percent slopes, is the only soil in this unit. It is a very poorly drained silty soil that is underlain by sandy loam till.

Permeability is moderately slow, and available water capacity is high. This soil receives runoff from adjoining areas and water ponds on it in spring and after heavy rains. Unless the soil is drained, a perched water table is at or near the soil surface throughout most of the year. Natural fertility is medium. Runoff is very slow and slow, and the hazard of erosion is slight.

Diversions and surface drainage help remove surface water and help prevent ponding, but drainage is difficult because outlets are not well developed. This soil forms major drains in the ground moraine. The drains are long and narrow, but channels are too small and too blocked to adequately handle the runoff water.

Where drained and protected from flooding, this soil is suited to corn and other row crops. Undrained areas are not suited to row crops or cultivation, but they are suited to wetland pasture and wildlife habitat.

CAPABILITY UNIT IVw-5

Duelm loamy sand is the only soil in this unit. This is a somewhat poorly drained sandy soil that is underlain by sand. Slopes are 0 to 2 percent.

Permeability is rapid, and available water capacity is low. Unless this soil is drained, the substratum is saturated by ground water throughout the year. This soil receives runoff from adjoining areas. Natural fertility is low. Runoff is very slow, and the hazard of erosion is slight.

Deep ditches can be used to lower the water table if a suitable outlet is available. Diversions and grassed waterways can be used to intercept and safety remove runoff received from adjoining areas, and surface drainage can be used to remove surface water and prevent ponding. Where drained, this soil is subject to soil blowing. Where excessively drained, this soil loses the beneficial effects of free water in the lower part of the soil.

Such conservation practices as controlled drainage, windbreaks, minimum tillage, and good management of crop residue help control soil blowing and maintain organic matter content and available water capacity. Adequate fertility maintains plant cover, which helps control soil blowing. The suitability of this soil for crops is limited by low available water capacity. Heavy fertilization is not generally economical because fertilizer elements leach quickly. Pollution of ground water by leaching of fertilizer elements, especially nitrates, is a hazard.

Where adequately drained and properly managed, this soil is suited to row crops, small grain, and hay. Undrained soils are poorly suited to row crops and alfalfa, but they are moderately well suited to pasture, trees, and wildlife habitat.

CAPABILITY UNIT IVw-9

Seelyeville muck is the only soil in this unit. This is a very poorly drained, organic soil. It is muck to a depth of more than 51 inches. Slopes are 0 to 2 percent.

Permeability is moderately rapid, and available water capacity is very high. Natural fertility is low. Unless this soil is drained, ground water is at or near the surface throughout the year. The soil receives runoff from adjoining areas, and some areas are subject to ponding and overflow. This soil is in low areas where frost is common late in spring and early in fall, unless the soil is drained.

Tile drainage and deep ditches can be used to lower the water table if a suitable outlet is available. In many places outlets are not available. Diversions and grassed waterways can be used to intercept and safely remove runoff received from adjoining areas. Surface drainage can be used to remove surface water and prevent pond-

Figure 8.—**Ten year old red pine windbreak growing on nearly level Hubbard soil. Soil blowing is a hazard in cultivated areas of these and other sandy, droughty soils.**

ing. Where drained, this soil is subject to soil blowing, burning, and subsidence. If the water table is lowered excessively, this soil is subject to rapid subsidence.

Where properly drained and protected from flooding and soil blowing, this soil is poorly suited to most cultivated crops because of frost late in spring and early in fall. Undrained areas are suited to pasture but are better suited to wetland wildlife habitat.

CAPABILITY UNIT IVs-3

This unit consists of nearly level to sloping, excessively drained and somewhat excessively drained soils. These are sandy soils that are underlain by sand or by soft sandstone.

Available water capacity is low. The soils of this unit are not saturated with water for periods long enough to adversely affect plant growth. Natural fertility is low. Runoff is very slow or slow, and the hazard of erosion is slight. The soils are droughty; they are subject to soil blowing.

Such conservation practices as crop rotations that consist of some sod cover crops, contour farming, stripcropping, windbreaks, minimum tillage, and good management of crop residue help control soil blowing and maintain organic matter content and available water capacity (fig. 8). Adequate fertility helps to maintain plant cover which helps to control soil blowing and erosion.

The suitability of these soils for crops is limited by low available water capacity. Low available water capacity limits crop response to fertilizer. Heavy fertilization is not generally economical. Fertilizer elements leach through these sandy soils, especially nitrates, and pollution of ground water is a hazard. Irrigation may be feasible in some areas, especially where vegetable crops are grown.

If properly managed, the soils in this unit are suited to a cropping system that includes row crops, small grain, and hay. Planting early in spring, before the soil has a chance to dry, is best on these soils. Later plantings, especially of small seeded crops, have a poor chance of survival. The nearly level and gently sloping soils are suited to irrigation. If irrigated, they are suited to more intensive crop production. These soils are suited to pasture.

CAPABILITY UNIT Vw-14

Fluvaquents, wet, are the only soils in this unit. These nearly level, poorly drained, and very poorly drained soils are on flood plains. The meandering stream channels, oxbows, and sloughs, and the hazard of flooding limit the use of these soils. Slopes are 0 to 2 percent.

Permeability, natural fertility, and available water capacity are too variable to rate. Texture varies from sand to silt loam. Unless the soils are drained, ground water is at or near the surface throughout the year.

Drainage and protection from flooding are generally impractical. Many areas of these soils are wooded or in pasture. The soils are poorly suited to pasture. They are better suited to woodland or wetland wildlife habitat.

CAPABILITY UNIT VIe-1

Amery loam, 20 to 30 percent slopes, eroded, is the only soil in this unit. It is a steep, well drained, loamy soil that is underlain by sandy loam till.

Permeability is moderate, and available water capacity is moderate. This soil is not saturated with water for periods long enough to adversely affect plant growth. Natural fertility is low or medium. Runoff is very rapid, and the hazard of erosion is very severe.

Pasture and hayfields are difficult to renovate. Controlled grazing, renovation, and fertilization help maintain adequate plant cover and control erosion.

Because of the very severe hazard of erosion, this soil is generally not suited to cultivated crops. If properly managed, it is suited to pasture. The soil is used mostly for pasture, woodland, and wildlife habitat.

CAPABILITY UNIT VIe-3

This unit consists of moderately steep and steep soils that are somewhat excessively drained and well drained. These are loamy soils that are underlain by dolomitic limestone or by sand and gravel, generally at a depth of less than 20 inches.

Permeability is moderate and moderately rapid in the subsoil and the substratum but is rapid where the substratum is sand and gravel. The available water capacity is low in soils in this unit, except in a few small areas where the soil is more than 20 inches thick over sand and gravel; in these areas available water capacity is moderate. The depth of the root zone is generally limited by sand and gravel or by limestone bedrock. This soil is not saturated with water for periods long enough to adversely affect plant growth. Natural fertility is low or medium. Runoff is rapid or very rapid, and the hazard of erosion is severe or very severe. Soil blowing is a moderate hazard in some soils of this unit.

Pasture and hayfields are difficult to renovate. Controlled grazing, renovation, and fertilization help maintain adequate sod cover and control erosion.

Because of the severe hazard of erosion, the shallow root zone, and the low available water capacity, these soils are generally not suited to cultivated crops. If properly managed, they are suited to hay and pasture. They are also well suited to woodland and wildlife habitat.

CAPABILITY UNIT VIe-4

This unit consists of moderately steep and steep soils that are somewhat excessively drained and well drained. These are loamy soils that are underlain mainly by sandy loam till that is mixed with sand and gravel in some areas.

Permeability is generally moderate but ranges to rapid in some areas that are underlain by sand and gravel. Available water capacity is moderate in all soils in this unit except in a few small areas where the soil has a sandy substratum; in these areas available water capacity is low. This soil is not saturated with water for periods long enough to affect plant growth. Natural fertility is medium or low. Runoff is rapid or very rapid, and the hazard of erosion is severe or very severe.

Pasture and hayfields are difficult to renovate. Controlled grazing, renovation, and fertilization help maintain adequate sod cover and control erosion.

Because of the severe hazard of erosion, these soils are generally not suited to cultivated crops. If properly managed, they are suited to hay and pasture. They are also well suited to woodland and wildlife habitat.

CAPABILITY UNIT VIe-3

This unit consists of sloping soils that are excessively drained. These are sandy soils that are underlain by sand or by soft sandstone.

Permeability ranges from very rapid to moderately rapid, and available water capacity is low. These soils are not saturated with water for periods long enough to adversely affect plant growth. Natural fertility is low. Runoff is slow, and the hazard of erosion is slight. The hazard of soil blowing is severe.

Establishing plant cover is difficult. Planting pasture and hay early in spring, before the soil has a chance to dry, is best on these soils. Later plantings have a poor chance of survival. Controlled grazing, renovation, and fertilization help maintain plant cover and control erosion and soil blowing. Pollution of ground water by leaching of fertilizer elements, especially nitrates, is a hazard in these sandy soils.

Because of low available water capacity and the severe hazard of soil blowing, these soils are generally not suited to cultivated crops. If properly managed, they are suited to pasture and hay, but yields are low. These soils are used mostly for woodland and wildlife habitat.

CAPABILITY UNIT VIIe-2

Arland sandy loam, 25 to 35 percent slopes, is the only soil in this unit. It is a well drained, loamy soil that is underlain mainly by soft sandstone. Among the included soils in this mapping unit is a sandy loam soil underlain by loamy residuum.

Permeability is moderate, and available water capacity is low or moderate. The water table is deep, so the

soils in this unit are not saturated with water for periods long enough to adversely affect plant growth. Natural fertility is low or medium. Runoff is very rapid, and the hazard of erosion is very severe. The topsoil is thin, and in some areas that have been overgrazed the soil is eroded. Controlled grazing helps maintain plant cover and control erosion.

Because of the very severe hazard of erosion this soil is not suited to commercial crop production. It is poorly suited to pasture because establishing and maintaining good grassland is difficult. The soil is suited mainly to woodland and wildlife habitat.

CAPABILITY UNIT VIIe–3

This unit consists of steep and very steep soils that are somewhat excessively drained and well drained. These are loamy soils that are underlain by sand and gravel or by limestone, generally at a depth of less than 20 inches.

Permeability is moderate or moderately rapid in the subsoil and in the substratum but rapid where the substratum is sand and gravel. Available water capacity is low in all soils in this unit except in a few, small areas where the soil is more than 20 inches thick over sand and gravel; in these areas available water capacity is moderate. The water table is deep, so the soils of this unit are not saturated with water for long enough periods to adversely affect plant growth. Natural fertility is low or medium. Sand and gravel or limestone at a shallow depth restrict root development and plant growth. Runoff is very rapid, and the hazard of erosion is very severe. Soil blowing is a moderate hazard on some soils in this unit.

The topsoil is thin. In some areas that have been overgrazed the soils are severely eroded. Gravelly spots and rock outcrops are common in some places. Controlled grazing helps maintain plant cover and control erosion.

Because of low available water capacity, a shallow root zone, and the very severe hazard of erosion, these soils are not suited to commercial crop production. They are also generally not suited to pasture. They are suited to trees and wildlife habitat.

CAPABILITY UNIT VIIs–3

This unit consists of moderately steep soils that are excessively drained. There sandy soils are underlain by sand or soft sandstone.

Permeability ranges from moderately rapid to very rapid, and available water capacity is low. These soils are not saturated with water for periods long enough to adversely affect plant growth. Natural fertility is low. Soil blowing is a severe hazard. Runoff is medium, and the hazard of water erosion is moderate.

Establishing plant cover is difficult. Controlling grazing and topdressing with fertilizer help maintain plant cover and control erosion and soil blowing. Pollution of ground water by leaching of fertilizer elements, especially nitrates, is a hazard in this sandy soil.

Because of low available water capacity, moderately steep slopes, and the high susceptibility to soil blowing, these soils are not suited to commercial crop production. They are also generally not suited to pasture. Improved pasture is difficult to establish and maintain; many pasture areas of this soil are in native bluegrass. This soil is mostly suited to woodland and wildlife habitat.

CAPABILITY UNIT VIIs–5

Emmert loamy sand, 12 to 35 percent slopes, is the only soil in this unit. It is an excessively drained sandy soil that is underlain by sand and gravel at a depth of less than 20 inches. Some areas of this soil are gravelly.

Permeability is very rapid, and available water capacity is very low. This soil is not saturated with water for periods long enough to adversely affect plant growth. Natural fertility is low. Runoff is medium or rapid, and the hazard of erosion is moderate.

Some areas of this soil that have been overgrazed are eroded. Controlling grazing and topdressing with fertilizer help maintain plant cover and control erosion.

Because of the very low available water capacity, the shallow root zone, and the moderate hazard of erosion, and because the soil is gravelly, this soil is not suited to commercial crop production. If properly managed, some of the less sloping areas are suited to pasture, but yields are low. Improved pasture is difficult to establish and maintain; many pasture areas of this soil are in native bluegrass. This soil is mostly suited to woodland and wildlife habitat.

CAPABILITY UNIT VIIs–9

Udifluvents are the only soils in this unit. These sandy soils are nearly level, moderately well drained, and somewhat poorly drained.

Permeability is rapid, and the available water capacity is low. These soils receive runoff from adjacent upland areas and overflow from streams; this causes frequent ponding and occasional flooding. Sandy sediment is deposited during each flood. Depth to the seasonal high water table ranges from 2 to 5 feet. Natural fertility is low. Runoff is very slow. Generally, the hazard of erosion is slight, but during floods the hazard of streambank and gully erosion is severe.

Surface drainage, water diversions, and dikes can be used to remove surface water and prevent flooding and ponding. Fencing cattle from streambanks, riprap along streambanks, and maintaining a good sod cover help control erosion during flooding.

Because of the low available water capacity, the low natural fertility, and the high susceptibility to flooding, these soils are not suited to commercial crop production. They are poorly suited to pasture. These soils are mostly suited to woodland and wildlife habitat.

CAPABILITY UNIT VIIIw–15

Saprists and Aquents are the only soils in this unit. They are very poorly drained, nearly level soils that consist of sandy, loamy, and mucky sediment covered by water. They are in depressions and in areas bordering lakes and rivers. Native vegetation is cattails, sedges, and other marsh plants that grow in shallow water.

The soils of this unit are very wet. They are unsuited to common farm crops or pasture. Generally they are difficult to drain because they lack suitable outlets. The soils are suited to wetland habitat that serves as food and cover for waterfowl and other wetland wildlife. In dry seasons the soils of this unit need protection from grazing and burning. Where they consist mainly of

sediment, potholes for use by waterfowl and other wildlife can be formed by blasting.

Predicted yields

Table 2 gives predicted average yields per acre for the main crops grown in St. Croix County. Predictions are based on results obtained by the agricultural experiment station on experimental test plots and on observations made by soil scientists and other agricultural workers who are familiar with the soils (*4*). All yields are based on averages obtained over a long period of time and assume an average amount of rainfall. By using improved crop varieties and management, higher yields than those shown in the table are being obtained by many farmers. This trend can be expected to continue. This table will continue to have value as the general level of crop yields increases, because it also gives an idea of the relative productivity of the soils. It must be remembered, however, that improvement in technology in the future may affect some soils more than others. Also, some soils that have low to medium yields because they have low available water capacity may be well suited to intensive production of specialty crops if irrigated.

The yields of oats refer to oats seeded wtih a legume-grass mixture. Yields of oats higher than those shown in the table result in a poor stand of grass-legume mixture. Yields for alfalfa-brome hay in table 2 refer to those from well established, first-year and second-year stands. Yields of native bluegrass pasture are commonly grown on many soils that are too strongly sloping for renovation or for row crops.

The management needed to obtain the yields shown in table 2 is considerably above average for the county. Under this level of management, acid soils are limed to about pH 6.5, according to recommendations resulting from soils tests. Fertilizer is also applied according to recommendations based on soil tests. Adequate surface or internal drainage is provided, and soils are protected from flooding, if necessary. Seedbed preparation is adequate and timely. Proper planting methods are used. Harvesting of crops is timely and carefully performed. Necessary erosion control practices are installed and maintained. Cropping systems are suitable for the soil and slope. Annual and perennial weeds are controlled by timely use of mechanical and chemical methods. Insects that damage crops are controlled.

Woodland[3]

Before settlement, much of St. Croix County was forested. The exception was an extensive area of tall grasses on prairie which stretched from the south boundary almost to Polk County on the north through the middle of the county. Big and little bluestem, along with switchgrass, indiangrass, and prairie forbs were dominant. To the west of this grassland area, an open-grown stand of oak was intermingled with the same prairie vegetation. The east side of the county was more heavily forested with sugar maple, basswood, red oak, and some red and white pine (*6*).

The coming of farming and control of wildfires encouraged invasion of grassland by trees and brush.

[3]By GEORGE W. ALLEY, forester, U.S. Soil Conservation Service.

Figure 9.—**Thinning a pine plantation grown on Boone soils. These trees are used for fence posts, poles, or pulpwood.**

In a 1968 inventory of the forest resources, 50,000 acres, or about 11 percent of the land area, was in commercial woodland (fig. 9). The woodland is about 55 percent oak and hickory; 20 percent sugar maple; 13 percent aspen and white birch; 4 percent conifers; 4 percent elm, ash, and cottonwood; and 4 percent is not stocked (*30*).

Woodland groups

The soils of St. Croix County have been placed in woodland suitability groups to help owners plan the use of their soils for wood crops. Each group is made up of soils that are suited to the same kinds of trees; that need approximately the same kind of management when the vegetation on them is similar; and that have about the same potential productivity.

Each woodland group is identified by a three-part symbol, such as 1o1, 2r1, or 3s2. The first part of the symbol, always a number, indicates relative potential productivity of the soils in the group: 1 is very high; 2 is high; 3 is moderately high; 4 is moderate; 5 is low; and 6 is unproductive. These ratings are based on field determinations of average site index. Site index is the height, in feet, that the dominant trees of a given species on a specific kind of soil reach in a natural, unmanaged stand in a stated number of years. For the merchantable hardwoods and softwoods in this county, the site index is the height reached in 50 years, except for cottonwood, for which the site index is height reached in 30 years.

The six foregoing ratings are based on field determination of the average site index of an indicator forest type or species. Site indexes are grouped into site quality classes, and the classes are used to arrive at approximate expected yields per acre in cords and board feet. On the basis of research studies, site index can be converted into approximate expected growth and yield per acre in cords and board feet. For this survey

conversions of average site index into volumetric growth and yield are based on recognized site index curves for red oak (*22*), aspen (*13*), sugar maple (*7*), white ash (*7*), white pine (*16*), red pine (*17*), red maple (*11*), basswood (*18*), swamp white oak (*22*), black ash (*18*), balsam fir (*14*), northern white cedar (*15*), tamarack (*19*), and jack pine (*12*).

Annual yields for tree species were estimated from yield tables based on site indexes for upland oak (*22*), aspen (*20*), sugar maple (*21*), white pine (*3*), red pine (*8*), and jack pine (*9*).

The second part of the symbol identifying a woodland group is a small letter. This letter indicates an important soil property that imposes a slight to severe hazard or limitation in managing the soils of the group for wood crops. A letter *c* shows that the main limitation is the kind or amount of clay in the upper part of the soils in the group: *o* shows that the soils have few limitations that restrict their use for trees; *r* shows that the main limitation is steep slopes; *s* shows that the soils are sandy and dry, have little or no difference in texture between surface layer and subsoil (or B horizon), have low available water capacity, and generally have a low supply of plant nutrients; *w* shows that water in or on the soil, either seasonally or year round, is the chief limitation.

The third part of the symbol, a number, shows the degree of hazard or limitation and general suitability of the soils for certain kinds of trees. The number *1* indicates soils that have no limitations or only slight limitations and that are best suited to needleleaf trees. The number *2* indicates soils that have one or more moderate limitations and are best suited to needleleaf trees. The number *3* indicates soils that have one or more severe limitations and that are best suited to needleleaf trees. The number *4* indicates soils that have no limitations or only slight limitations and are best suited to broadleaf trees. The number *5* indicates soils that have one or more moderate limitations and are best suited to broadleaf trees. The number *6* indicates soils that have one or more severe limitations and are best suited to broadleaf trees. The number *7* indicates soils that have no limitations or only slight limitations and are suited to either needleleaf or broadleaf trees. The number *8* indicates soils that have one or more moderate limitations and are suited to either needleleaf or broadleaf trees. The number *9* indicates soils that have one or more severe limitations and are suited to either needleleaf or broadleaf trees. The number *0* indicates that the soils are not suitable for producing timber commercially.

In table 3 the soils are placed in woodland suitability groups, ratings for management limitations of the soils are given, and some of the preferred timber species and their average site indexes are shown.

The hazards or limitations that affect management of soils for woodland are equipment limitations, erosion hazard, and seedling mortality.

To facilitate management, the soils of St. Croix County have been placed in woodland groups. An important part of the description of each woodland group is the verbal ratings made for the limitation of equipment, hazard of erosion, and hazard of seedling mortality. These ratings are always *slight*, *moderate*, or *severe*. The following explanations of these ratings apply to the descriptions of all the woodland groups in St. Croix County.

Equipment limitations are rated on the basis of soil characteristics that restrict or prohibit the use of equipment for tending and harvesting the trees. In St. Croix County the limiting soil characteristics are drainage, depth to the water table, slope, and texture of the surface layer. *Slight* means there is no restriction in the kind of equipment or in the time of year it is used; *moderate* means that use of equipment is restricted for less than 3 months of the year; and *severe* means that special equipment is needed and its use is restricted for more than 3 months of the year.

Erosion hazard refers to the potential hazard of soil losses in woodland. The hazard is *slight* if expected soil losses are small; *moderate* if some soil losses are expected and care is needed during logging and construction to reduce soil losses; *severe* if special methods of operation are necessary to prevent excessive soil losses. In St. Croix County only the steep soils are subject to severe erosion.

Seedling mortality refers to the expected degree of mortality of planted seedlings as influenced by kinds of soil when plant competition is not a limiting factor. Considered in the ratings are depth to the water table, hazard of flooding, drainage, soil depth and structure, and degree of erosion. Normal rainfall, good planting stock, and proper planting are assumed. A rating of *slight* indicates an expected loss of less than 25 percent of the planted seedlings; *moderate*, a loss of 25 to 50 percent of seedlings; and *severe*, a loss of more than 50 percent of the seedlings. Special preparation of the site is needed before planting for soils rated severe and for most soils rated moderate.

Landscaping and windbreak plantings

This section gives information about some of the trees, shrubs, and vines used in landscaping sites for homes, schools, industry, and recreation areas. It also provides information on species suitable for windbreaks around farmsteads or open fields.

Height growth of trees in windbreaks has been measured on several of the more important soil series in Wisconsin, including Plainfield, Gotham, and Burkhardt soils. On these and similar soils, white pine and red pine are generally about 30 feet tall at 20 years. Jack pine at 20 years is about 25 feet tall.

Different soils vary widely in suitability for different trees and shrubs and in site conditions. The soils in the county have been placed in four tree and shrub groups. These groups are based mainly on degree and length of time that soil is saturated with water and on the available water capacity. Each of the soils in a specific group has similar suitability for tree, shrub, and vine plantings.

A brief general description of the soils in each tree and shrub group and the mapping units in that group are listed in tables 4 and 5. Cut and fill areas (Cz), Gravel pits (Gp), and Saprists and Aquents (Se) have not been placed in a tree and shrub group. The tree and shrub group of each soil can also be found by referring to the "Guide to Mapping Units" at the back of this survey. On the other hand, the tree and shrub group listed in "Guide to Mapping Units" can be used to find information in tables 4 and 5.

TABLE 3.—*Woodland*

Woodland groups and map symbols [1]	Potential productivity of the soils				Trees to select for planting	Equipment limitations	Erosion hazard	Seedling mortality
	Kinds of trees	Average site index	Number of plots	Yearly growth per acre				
				Fbm				
Group 1o1: FnB, FoB, FoC2, OtB, OtC, SaB, SaC2, ScC2.	Red oak [2]	67±5.0	13	230	Eastern white pine, red pine, and white spruce.	Slight	Slight	Slight.
	Aspen	72	2	245				
	Sugar maple	67	1	110				
	White ash	70	1					
Group 1r1: OtD2, ScD2.	Red oak [2]	70	([3])	250	Eastern white pine, red pine, and white spruce.	Moderate	Moderate	Slight on north and east facing slopes; moderate on south and west facing slopes.
	Aspen	72	([3])	245				
	Sugar maple	67	([3])	110				
	White ash	70	([3])					
Group 2o1: AlB, AlC2, AmB, AmC2, AnC2, AoA, AoB, ApC2, AsB, AsC2, BpA, DeB, DeC2, HuA, JeA, Jeb, JeC2, JsA, JsB, OmB, OmC2, OnC2, ReB, ReC2, RgC2, ShA, ShB, ShC2, SlA, SlB, VaB, VaC2, WhB, WhC2.	Red oak [2]	64±5.1	10	215	Eastern white pine, red pine, and white spruce.	Slight	Slight	Slight.
	Aspen	74±7.2	5	255				
	Sugar maple	61	3	95				
	White pine	59	2	400				
	Red pine	53	1	270				
	Red maple	75	1					
Group 2r1: AlD2, AmD2, AmE2, AnD2, ApD2, ApF, OnD2, RgD2, WhD2.	Red oak [2]	64	([3])	215	Eastern white pine, red pine, and white spruce.	Moderate	Moderate	Slight on north and east facing slopes; moderate on south and west facing slopes.
	Aspen	74	([3])	255				
	Sugar maple	61	([3])	95				
	White pine	59	([3])	400				
Group 2o2: MaB, SrA.	Red oak	64±2.6	4	210	Eastern white pine, red pine, white spruce, red maple, and white and green ash.	Slight	Slight	Slight.
	Red maple	65±5.0	6					
	Sugar maple	58	3	85				
	Basswood	69	3					
	White and green ash	62	3					
	Swamp white oak	62	2	210				
Group 3w2: AuA, RhA.	Red maple	60	2		Red maple, white ash, and poplar species.	Moderate to severe.	Slight	Moderate to severe.
	Black ash	47	1					
	Balsam fir	49	1					
	Aspen	68	1	220				
Group 3w3: Sm	Northern white cedar	35	([3])	[3] 50	Unsuitable for planting.	Severe	Slight	Severe.
	Tamarack	50	([3])	[3] 95				
	Tree growth on these soils is generally limited to tamarack, northern white cedar, elm, or willow. Occasionally silver maple, red maple, or white ash becomes established and makes rapid growth. Woodland management is difficult because of soil-based hazards.							

TABLE 3.—*Woodland*—Continued

Woodland groups and map symbols [1]	Potential productivity of the soils				Trees to select for planting	Equipment limitations	Erosion hazard	Seedling mortality
	Kinds of trees	Average site index	Number of plots	Yearly growth per acre				
				Fbm				
Group 3d1: BrB, BrC2, BxB, BxC2, CoC2, RnB, RnC2.	Red oak [2]	55	([3])	160	Red pine, jack pine, and eastern redcedar.	Slight	Slight	Moderate.
	Jack pine	55	([3])	180				
Group 3d2: BxD2, CoD2, CoE, RnD2, RoE.	Red oak [2]	55	([3])	160	Red pine, jack pine, and eastern redcedar.	Moderate	Severe	Moderate.
	Jack pine	55	([3])	80				
Group 3s1: BnB, BnC, GoB, GoC, HrB, HsB, HsC, PmB, PmC, Ud.	Black oak	51	4	130	Red pine, jack pine, and eastern redcedar.	Slight	Slight	Moderate.
	Northern pin oak	56	2	110				
	White pine	59	2	400				
	Jack pine	58	2	95				
Group 3s2: Du	Jack pine	55	([3])	75	Eastern white pine, red pine, and red maple.	Slight	Slight	Moderate.
	Aspen	60	([3])	150				
	Red maple	55	([3])	----				
Group 3s3: BnD, PmD.	Black oak	41	4	80	Red pine, jack pine, and eastern redcedar.	Severe	Moderate	Moderate on north and east facing slopes; severe on south and west facing slopes.
	Northern pin oak	37	2	80				
	White pine	50	([3])	220				
	Jack pine	42	2	35				
Group 3o1: DkB, HeB, HeC2.	Red oak [2]	55	([3])	160	Eastern white pine, red pine, and white spruce.	Slight	Slight	Slight.
	Sugar maple	50	([3])	60				
Group 3r1:HeD2	Red oak [2]	55	([3])	160	Eastern white pine, red pine, and white spruce.	Moderate	Moderate	Slight on north and east facing slopes; moderate on south and west facing slopes.
	Sugar maple	50	([3])	60				
Group 3o2: DfB, Fe, HaA, OrA.	Northern red oak	60	([3])	190	Eastern white pine, white spruce, red pine, and red maple.	Slight	Slight	Slight.
	Red maple	60	([3])	----				
	White ash	60	([3])	----				
Group 4w2: CyA, Fm.	Red maple	50	([3])	----	Red maple and white ash.	Severe	Slight	Moderate to severe.
	White ash	45	([3])	----				
	American elm	----	([3])	----				
Group 4f2: EmE	Black oak	40	([3])	80	Red pine, jack pine, and eastern redcedar.	Severe	Severe	Severe.
Group 4o1: FdA, LcA.	Northern red oak	35	([3])	----	Eastern white pine, white spruce, and red pine.	Slight	Slight	Slight.
	White ash	50	([3])	----				
	Red maple	50	([3])	----				
Group 5w1: AdA	Black ash	35	([3])	----	White spruce and black spruce.	Severe	Slight	Severe.

TABLE 3.—*Woodland*—Continued

Woodland groups and map symbols [1]	Potential productivity of the soils				Trees to select for planting	Equipment limitations	Erosion hazard	Seedling mortality
	Kinds of trees	Average site index	Number of plots	Yearly growth per acre				
				Fbm				
Group 6w1: Se	Not suited for woodland use		[3]		Unsuitable for planting.	Severe	Slight	Severe.
	Willows		[3]					

[1] The following mapping units have soils that are highly productive and are generally used for producing farm crops, or they are disturbed areas not generally farmed. They are not naturally forested: Cz, DaA, DaB, DcC2, Gp, NcB, NcC2, NnD2, PlA, PoB, PoC, PoD, RpB, RpC2, and RpD2.

[2] Includes estimates for northern red oak and black oak; and in places northern pin oak.

[3] Data estimated for this kind of tree.

Table 4 lists trees suitable for specified uses and gives information on growth form and height at maturity. Table 5 lists shrubs and vines suitable for specified uses and gives information on growth form and aesthetic value. It is only a partial list of the plants suited to soils in the county. Many of the plants can be used for both landscaping and providing food and cover for wildlife.

Wildlife [4]

The soils of St. Croix County differ widely in physical and chemical characteristics. These characteristics affect the kind and amounts of vegetation and wildlife the soils will support. Research has indicated a direct

[4] By LAVERNE C. STRICKER, biologist, Soil Conservation Service.

TABLE 4.—*Trees suitable*

[The first letter in parentheses following the plant name indicates the location: A is for sunny sites and B is for partly shady sites. is columnar, O is oval, P is pyramidal,

Tree and shrub groups and map symbols	Shade trees	Trees along streets
Group 1. Moderately deep and deep, moderately well drained to somewhat excessively drained, medium textured soils that have low to very high available water capacity: AlB, AlC2 AlD2, AmB, AmC2, AmD2, AmE2, AnC2, AnD2, AoA, AoB, ApC2, ApD2, ApF, AsB, AsC2, BpA, DaA, DaB, DcC2, DeB, DeC2, FnB, FoB, FoC2, HeB, HeC2, HeD2, HsB, HsC, HuA, JeA, JeB, JeC2, JsA, JsB, NcB, NcC2, NnD2, OmB, OmC2, OnC2, OnD2, OtB, OtC, OtD2, PlA, PoB, PoC, PoD, ReB, ReC2, RgC2, RgD2, RpB, RpC2, RpD2, SaB, SaC2, ScC2, ScD2, ShA, ShB, ShC2, SlA, SlB, VeB, VaC2, WhB, WhC2, WhD2.	American beech (ABLO), sugar maple (ABLO), red maple (ABMO), red oak (ABLR), white oak (ALR), basswood (ABLO), hackberry (ABMR), white ash (ABLO), basswood (BLO), sycamore (ALO), bur oak (ALR), Norway maple (AMR), silver maple (ALO), and thornless honeylocust (AMO).	Norway maple (ABMR), southern pin oak (AMP), thornless honey locust (AMO), basswood (ABLO), white ash (ABLO), sugar maple (ABLO), hackberry (AMR), and red maple (AMO).
Group 2. Shallow to deep, mainly moderately well drained to excessively drained, medium and coarse textured soils that have moderate to very low available water capacity: BnB, BnC, BnD, BrB, BrC2, BxB, BxC2, BxD2, CoC2, CoD2, CoE, DkB, EmE, GoB, GoC, HrB, PmB, PmC, PmD, RnB, RnC2, RnD2, RoE, Ud.	Bur oak (ALR), hackberry (ABMR), black oak (ALR), silver maple (ALO), green ash (AMO), and thornless honeylocust (AMO).	Green ash (AMO), white ash (ALO), hackberry (ABMR), and thornless honeylocust (AMD).
Group 3. Mainly somewhat poorly drained to very poorly drained mineral soils: AdA, AuA, CyA, DfB, Du, FdA, Fe, Fm, HaA, LcA, MaB, OrA, RhA, SrA.	Swamp white oak (ABLR), hackberry (ABMR), red maple (ABMO), basswood (ABLO), green ash (ABMO), white ash (ABLO), silver maple (ALO), and cottonwood (ALO).	Green ash (ABMO), basswood (ABLO), and red maple (ABMO).
Group 4. Very poorly drained organic soils: Sm.	Silver maple (ALO) and red maple (ABMO).	Red maple (AMO), and laurel willow (AMO).

relationship between soil fertility and wildlife numbers and vigor. This correlation is applicable to upland and wetland soils, plants and animals, and domestic animals and wildlife.

Food and cover planting on soils used primarily or secondarily for wildlife production are expected to encourage wildlife. Stripcropping, fertilization of the soil, and tree planting in pasture, woodland, or other areas benefit wildlife.

Most of the major soils are suitable for fairly intensive farming. These soils have high potential for wildlife but, because of other uses, there is little wildlife habitat.

The soils of St. Croix County have been placed in 10 wildlife groups, according to a statewide system of grouping and identification. Groups 6, 7, and 8, the somewhat poorly drained to very poorly drained soils, contain the valuable wetlands which are the most important soils for wildlife in the county.

The soil survey of St. Croix County indicates that about 76,000 acres are designated as wet soils that have a permanent or seasonal high water table or are subject to flooding.

According to a 1967 survey, 15,100 acres were wet soils that remained in their natural condition as wetlands in the county. Approximately 20 percent of the original wetlands remain in the county, which affects the numbers and species of wildlife remaining in the county.

In table 6, (page 84), the wildlife groups are rated for their suitability in producing various elements of wildlife habitat. These elements are grain and seed crops, grasses and legumes, wild herbaceous upland plants, hardwood trees and shrubs, coniferous trees, wetland plants for food and cover, and shallow and deep water developments.

Grain and seed crops include corn, oats, sorghums, wheat, barley, rye, or soybeans that are used for food and cover by wildlife.

Grasses and legumes include such grasses as switchgrass, bromegrass, timothy, and fescue and such legumes as alfalfa, red clover, sweet clover, and vetch that are used by wildlife for food and cover.

Wild herbaceous upland plants include native or introduced grasses, legumes, and forbs that provide food and cover for upland wildlife and are mainly established by natural means. Important plants are bluegrass, roundhead lespedeza, beggarstick, aster, and goldenrod.

Woody plants include hardwood trees and shrubs and coniferous trees. Shrubs are low growing woody plants, including conifers less than eight feet tall, that furnish fruit, seeds, browse and cover for wildlife. Examples are viburnum, dogwood, and hazelnut. Such hardwood

for planting

Other letters indicate height: S is less than 30 feet, M is 30 to 60 feet, and L is more than 60 feet. These letters indicate shape: C Q is pendulus, and R is round.]

Trees for lawns	Plants for hedges and screens	Trees for windbreaks
Flowering crab (ASR), mountain ash (ASO), blue beech (ABSR), paper birch (AMO), river birch (AMO), Russian-olive (ASR), southern pin oak (AMP), serviceberry (ABSR), horse chestnut (ALR), Norway spruce (ALP), red pine (ALP), white pine (ABLP), white spruce (ABMP), black cherry (ALO), blue spruce (ABLP), Norway spruce (ABLP), and hawthorn (ASR).	Redcedar (ASP), white cedar (AMC, P and BMC), white pine (ABLP), white spruce (ABMP), lombardy poplar (ALC), Russian-olive (ASR), and upright yew (ABSP).	White spruce (ABMP), white cedar (ABMC, P), white pine (ABLP), red pine (ALP), and Norway spruce (ALP).
Flowering crab (ASR), paper birch (AMO), redcedar (ASP), white pine (ABLP), white spruce (ABMP), red pine (ALP), and Russian-olive (ASR).	Redcedar (ASP), Russian-olive (ASR), red pine (ALP), white pine (ABLP), upright yew (ABSP), and white spruce (ABMP).	Red pine (ALP), white pine (ABLP), and redcedar (ASP).
White spruce (ABMP), paper birch (AMO), mountain ash (ABSO), weeping willow (AMQ), white cedar (AMP), and river birch (AMO).	White cedar (ABMC), white spruce (ABMP), lombardy poplar (ALC), and laurel willow (AMO).	White cedar (ABMC), white spruce (ABMP), and white pine (ALP).
White cedar (ABMC), white spruce (ABMP), and weeping willow (AMQ).	White cedar (ABMC) and laurel willow (AMO).	Laurel willow (AMO), poplar selections (ALP), tree lilac (ASO), and white cedar (ABMC).

TABLE 5.—*Shrubs and vines suited to the soils*

[The letter X means that the plant is suitable for the uses in the column headings]

Tree and shrub group and map symbols	Common name	Type of plant	Potential height	Plants suitable for—				
				Landscaping	Hedge, screen, or windbreak	Wildlife food and cover	Roadside planting	Ground cover
			Ft					
Group 1. Moderately deep and deep, moderately well drained to somewhat excessively drained, medium textured soils that have low to very high available water capacity: AlB, AlC2, AlD2, AmB, AmC2, AmD2, AmE2, AnC2, AnD2, AoA, AoB, ApC2, ApD2, ApF, AsB, AsC2, BpA, DaA, DaB, DcC2, DeB, DeC2, FnB, FoB, FoC2, HeB, HeC2, HeD2, HsB, HsC, HuA, JeA, JeB, JeC2, JsA, JsB, NcB, NcC2, NnD2, OmB, OmC2, OnC2, OnD2, OtB, OtC, OtD2, PlA, PoB, PoC, PoD, ReB, ReC2, RgC2, RgD2, RpB, RpC2, RpD2, SaB, SaC2, ScC2, ScD2, ShA, ShB, ShC2, SlA, SlB, VaB, VaC2, WhB, WhC2, WhD2.	Arborvitae	Shrub	3–7	X	X	X		
	Barberry, Japanese	Shrub	6	X	X	X		
	Bittersweet	Vine		X		X	X	X
	Blackberry, dewberry, blackcap raspberry.	Bramble	1–5			X	X	X
	Chokeberry, black	Shrub	1–3	X		X	X	X
	Cotoneaster	Shrub	4–8	X	X	X		
	Crabapple	Shrub	10–25	X	X	X	X	
	Currant, alpine	Shrub	6–7	X	X			
	Dogwood, gray	Shrub	6–10			X	X	
	Dogwood, pagoda	Shrub	10–15			X	X	
	Dogwood, redosier	Shrub	3–9					
	Dogwood, roundleaf	Shrub	3–9			X	X	X
	Dogwood, silky	Shrub	6–10		X	X	X	
	Elder, American	Shrub	3–10			X	X	X
	Filbert (hazelnut)	Shrub	5–8			X	X	
	Forsythia	Shrub	4–8	X				
	Grape, wild	Vine				X	X	X
	Hawthorn or thornapple.	Shrub	5–15			X	X	
	Honeysuckle	Shrub	6–12	X	X	X		
	Juniper, creeping	Shrub	1–2	X		X	X	X
	Juniper, Pfitzer	Shrub	8–10	X		X		
	Lilac	Shrub	8–10	X	X		X	
	Maple, Amur	Shrub	1	X	X			
	Mockorange	Shrub	6–9	X	X			
	Myrtle or periwinkle	Vine	1	X			X	X
	Ninebark, common	Shrub	6–9	X	X		X	
	Olive, autumn	Shrub	10–15	X	X	X		
	Peashrub, Siberian	Shrub	10–15		X	X	X	
	Pine, mugho	Shrub	6–9	X		X		
	Plum, American	Shrub	10–15			X	X	
	Privet, Amur	Shrub	10		X	X		
	Privet, Regels border	Shrub	6–9		X	X		
	Redcedar, eastern	Shrub	6–9		X	X	X	
	Rose, rugosa and horticultural varieties.	Shrub	2–6	X		X	X	
	Russian-olive	Shrub	15+	X	X	X		
	Snowberry	Shrub	3–4	X		X	X	X
	Spirea, Anthony Waterer.	Shrub	2–3	X				
	Spirea, Vanhoutte	Shrub	5–6	X	X			
	Sumac, fragrant	Shrub	3	X		X	X	X
	Sumac, smooth	Shrub	6–10			X	X	
	Sumac, staghorn	Shrub	10–15			X	X	
	Viburnum, American cranberrybush.	Shrub	7–9	X	X	X	X	
	Viburnum, arrowwood	Shrub	10–12	X	X	X		
	Viburnum, blackhaw	Shrub	8–10		X	X	X	
	Viburnum, mapleleaf	Shrub	3–5			X	X	
	Viburnum, nannyberry	Shrub	9–12		X	X	X	
	Viburnum, Rafinesque	Shrub	2–4			X	X	
	Viburnum, wayfaring-tree.	Shrub	4–9	X		X	X	
	Virginia creeper	Vine				X	X	X
	Wahoo, Eastern	Shrub	4–9	X		X	X	
	Weigela	Shrub	4–8	X	X			
	Willows, shrubby types including pussy willow.	Shrub	2–8	X	X	X	X	
	Winterberry, common	Shrub	6–9			X	X	
	Yew, shrub type	Shrub	3–10	X		X		

TABLE 5.—*Shrubs and vines suited to the soils*—Continued

Tree and shrub group and map symbols	Common name	Type of plant	Potential height	Plants suitable for—				
				Landscaping	Hedge, screen, or windbreak	Wildlife food and cover	Roadside planting	Ground cover
			Ft					
Group 2. Shallow to deep, mainly moderately well drained to excessively drained, medium and coarse textured soils that have moderate to very low available water capacity: BnB, BnC, BnD, BrB, BrC2, BxB, BxC2, BxD2, CoC2, CoD2, CoE, DkB, EmE, GoB, GoC, HrB, PmB, PmC, PmD, RnB, RnC2, RnD2, RoE, Ud.	Arborvitae	Shrub	3–7	X	X	X		
	Barberry, Japanese	Shrub	6	X	X	X		
	Bayberry or waxmyrtle.	Shrub	5–9	X		X		X
	Bittersweet	Vine		X		X	X	X
	Blackberry, dewberry, blackcap raspberry.	Bramble	1–5			X	X	X
	Chokeberry, black	Shrub	1–3	X		X	X	X
	Cotoneaster	Shrub	4–8	X	X	X		
	Crabapple	Shrub	10–25	X	X	X	X	
	Currant, alpine	Shrub	6–7	X	X			
	Dogwood, gray	Shrub	6–10			X	X	
	Filbert (hazelnut)	Shrub	5–8			X	X	
	Forsythia	Shrub	4–8	X				
	Grape, wild	Vine				X	X	X
	Hawthorn or thornapple.	Shrub	5–15			X	X	
	Honeysuckle	Shrub	6–12	X	X	X		
	Juniper, creeping	Shrub	1–2	X		X	X	X
	Juniper, Pfitzer	Shrub	8–10	X		X		
	Lilac	Shrub	8–10	X	X		X	
	Maple, Amur	Shrub	1	X	X			
	Mockorange	Shrub	6–9	X	X			
	Myrtle or periwinkle	Vine	1	X			X	X
	Ninebark, common	Shrub	6–9	X	X		X	
	Olive, autumn	Shrub	10–15	X	X	X		
	Peashrub, Siberian	Shrub	10–15		X	X	X	
	Pine, mugho	Shrub	6–9	X		X		
	Plum, American	Shrub	10–15			X	X	
	Privet, Amur	Shrub	10		X	X		
	Privet, Regels border	Shrub	6–9		X	X		
	Redcedar, eastern	Shrub	6–9		X	X	X	
	Russian-olive	Shrub	15+	X	X	X		
	Snowberry	Shrub	3–4	X		X	X	X
	Spirea, Anthony Waterer.	Shrub	2–3	X				
	Spirea, Vanhoutte	Shrub	5–6	X	X			
	Sumac, fragrant	Shrub	3	X		X	X	X
	Sumac, smooth	Shrub	6–10			X	X	
	Sumac, staghorn	Shrub	10–15			X	X	
	Viburnum, blackhaw	Shrub	8–10		X	X	X	
	Viburnum, nannyberry	Shrub	9–12		X	X	X	
	Viburnum, Rafinesque	Shrub	2–4			X	X	
	Viburnum, wayfaringtree.	Shrub	4–9	X		X	X	
	Virginia creeper	Vine				X	X	X
	Willows, shrubby types including pussy willow.	Shrub	2–8	X	X	X	X	
Group 3. Mainly somewhat poorly drained to very poorly drained mineral soils: AdA, AuA, CyA, DfB, Du, FdA, Fe, Fm, HaA, LcA, MaB, OrA, RhA, SrA.	Arborvitae	Shrub	3–7	X	X	X		
	Bayberry or waxmyrtle.	Shrub	5–9	X		X		X
	Dogwood, gray	Shrub	6–10			X	X	
	Dogwood, pagoda	Shrub	10–15			X	X	
	Dogwood, redosier	Shrub	3–9					
	Dogwood, roundleaf	Shrub	3–9			X	X	X
	Dogwood, silky	Shrub	6–10		X	X	X	
	Elder, American	Shrub	3–10			X	X	X
	Hawthorn or thornapple.	Shrub	5–15			X	X	
	Honeysuckle	Shrub	6–12	X	X	X		
	Ninebark, common	Shrub	6–9	X	X		X	
	Olive, autumn	Shrub	10–15	X	X	X		
	Plum, American	Shrub	10–15			X	X	

TABLE 5.—*Shrubs and vines suited to the soils*—Continued

Tree and shrub group and map symbols	Common name	Type of plant	Potential height	Plants suitable for—				
				Landscaping	Hedge, screen, or windbreak	Wildlife food and cover	Roadside planting	Ground cover
			Ft					
	Group 3—con.							
	Russian-olive	Shrub	15+	X	X	X		
	Spirea narrowleaf	Shrub	3–4				X	
	Spirea, Vanhoutte	Shrub	5–6	X	X			
	Viburnum, American cranberrybush.	Shrub	7–9	X	X	X	X	
	Viburnum, mapleleaf	Shrub	3–5			X	X	
	Viburnum, nannyberry	Shrub	9–12		X	X	X	
	Viburnum, wayfaring-tree.	Shrub	4–9	X		X	X	
	Willows, shrubby types including pussy willow.	Shrub	2–8	X	X	X	X	
	Winterberry, common	Shrub	6–9			X	X	
Group 4. Very poorly drained organic soils: Sm.	Arborvitae	Shrub	3–7	X	X	X		
	Dogwood, redosier	Shrub	3–9					
	Dogwood, roundleaf	Shrub	3–9			X	X	X
	Dogwood, silky	Shrub	6–10		X	X	X	
	Elder, American	Shrub	3–10			X	X	X
	Honeysuckle	Shrub	6–12	X	X	X		
	Ninebark, common	Shrub	6–9	X	X		X	
	Spirea, narrowleaf	Shrub	3–4				X	
	Viburnum, American cranberrybush.	Shrub	7–9	X	X	X	X	
	Viburnum, mapleleaf	Shrub	3–5			X	X	
	Viburnum, nannyberry	Shrub	9–12		X	X	X	
	Viburnum, wayfaring-tree.	Shrub	4–9	X		X	X	
	Willows, shrubby types including pussy willow.	Shrub	2–8	X	X	X	X	
	Winterberry, common	Shrub	6–9			X	X	

trees as oaks, maples, cherry, and nut trees furnish mast, fruit, seeds, dens, cover, and browse for wildlife. Coniferous trees that are more than eight feet tall furnish seeds, fruit, browse, and cover for wildlife. Examples are pines, firs, spruce, tamarack, and cedar.

Wetland plants for food and cover include forbs, grasses, sedges, aquatic plants, and woody plants that grow well in wet areas. They furnish fruit, seeds, browse, and cover for wildlife that live in wet areas and on or near open water. Examples are smartweed, canarygrass, sedges, arrowhead, alder, and willow. These plants grow well in type 1, 2, and 6 wetlands as defined in U.S. Department of Interior Circular 39 (*23*). Type 1 wetlands are seasonally flooded basins and nearly level areas that are covered with water or saturated with water during seasonal wet periods but are generally relatively dry during much of the growing season. Type 2 wetlands include fresh meadows that are generally not covered by water during the growing season but are saturated within a few inches of the soil surface. Type 6 wetlands consist of shrub swamp areas in which the soil is generally saturated during the growing season.

Shallow water areas are areas where water is less than 5 feet deep. They are natural or artificial water areas formed by dug-out areas or low embankments, or both. Common plants are cattails, bulrushes, sedges, and reeds. Shallow water areas in St. Croix County are type 3 and 4 wetlands. Type 3 wetlands are shallow marshes where the soil is saturated or covered by as much as 6 inches of water during the growing season. Type 4 wetlands are deep marshes that are covered by 6 inches to about 3 feet of water during the growing season.

Deep water areas are more than 5 feet deep. They are naturally formed or are dug. Common plants are coontail, waterlilies, milfoil, and waterweed. The deep water areas consist of ponds, lakes and type 5 wetlands. Type 5 wetlands are open freshwater areas that include shallow ponds and reservoirs or wet areas where water is less than 10 feet deep.

In 1938 and 1967 these types of wetland covered the following acreages in St. Croix County.

	1938	1967
Type 2	2,796	1,749
Types 3, 5	721	428
Type 6	3,337	1,500
Type 7	4,458	11,423
Total	11,312	15,100

Table 7 lists the important kinds of wildlife in St. Croix County and rates the importance of the various habitat elements to wildlife survival.

By using tables 6 and 7, the suitability of a particular soil for a given species of wildlife can be determined. For example, critical parts of the habitat for ring-necked pheasants are grass and legumes, wild herbaceous upland plants, and herbaceous wetland plants. Only a combination of soil groups would be well suited for all these habitat elements. An environment containing soils in group 1 (loamy, well drained soils) and group 8 (organic soils) would be desirable.

Recreation

Knowledge of soils is necessary in planning, developing, and maintaining areas used for recreation. The soils of St. Croix County have been placed in six recreation groups (table 8, p. 88). Gravel pits have not been classified in this grouping. A brief description of the main features of the soils in each group and the map symbols of the soils assigned to each group are given in this table. The soils are rated according to limitations that affect their use for playgrounds and intensive play areas, picnic grounds and extensive play areas, camp areas, path and trails, and golf course fairways.

In table 8, the soils are rated as having slight, moderate, or severe limitations for the specified uses. For all of these ratings, it is assumed that a good cover of vegetation can be established and maintained. A limitation of *slight* means that soil properties are generally favorable and limitations are so minor that they easily can be overcome. A *moderate* limitation can be overcome or modified by planning, by design, or by special maintenance. A *severe* limitation means that costly soil reclamation, special design, intense maintenance, or a combination of these, is required.

Playgrounds are areas used intensively for baseball, football, badminton, and similar organized games. Soils suitable for this use need to withstand intensive foot traffic. The best soils have a nearly level surface free of coarse fragments and rock outcrops. They have good drainage and are not subject to flooding during periods of heavy use. Their surface is firm after rains but not dusty when dry. If grading and leveling are required, depth to rock is important.

Picnic grounds are attractive natural or landscaped tracts used primarily for preparing meals and eating outdoors. These areas are subject to heavy foot traffic. Most of the vehicular traffic, however, is confined to access roads. The best soils are firm when wet but not dusty when dry, are not subject to flooding during the season of use, and do not have slope or stoniness that greatly increases cost of leveling sites or of building access roads.

Camp areas are used intensively for tents and small camp trailers and the accompanying activities of outdoor living. Little preparation of the site is required other than shaping and leveling for tent and parking areas. Camp areas are subject to heavy foot traffic and limited vehicular traffic. The best soils have mild slopes, good drainage, and a surface free of rocks and coarse fragments. They are not subject to flooding during periods of heavy use, and they have a surface that is firm after rains but not dusty when dry.

Paths and trails are used for local and cross country hiking or horseback riding. Design and layout should require little or no cutting and filling. The best soils are at least moderately well drained, are firm when wet but not dusty when dry, are flooded not more than once during the season of use, have slopes of less than 12 percent, and have few or no rocks or stones on the surface.

Golf course fairways are areas between greens or holes on the course. Ratings are for the undisturbed soil, which needs to withstand intensive foot and vehicular traffic. The best soils have good drainage, a surface free of rocks and coarse fragments, a high available water capacity, and moderate permeability. They are not subject to flooding during periods of heavy use. The soils should be relatively dry during the season of use and be capable of supporting a thick turf without special management.

Engineering [5]

This section is useful to planning commissions, town and city managers, land developers, engineers, contractors, farmers, and others who need information about soils used as structural material or as foundation upon which structures are built.

Among the properties of soils highly important in engineering are permeability, strength, compaction characteristics, soil drainage condition, shrink-swell potential, grain size, plasticity, and soil reaction. Also important are depth to the water table, depth to bedrock, and soil slope. These properties, in various degrees and combinations, affect construction and maintenance of roads, airports, pipelines, foundations for small buildings, irrigation systems, ponds and small dams, and systems for disposal of sewage and refuse.

Information in this section of the soil survey can be helpful to those who—

1. Select potential residential, industrial, commercial, and recreational areas.
2. Evaluate alternate routes for roads, highways, pipelines, and underground cables.
3. Seek sources of gravel, sand, or clay.
4. Plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for controlling water and conserving soil.
5. Correlate performance of structures already built with properties of the kinds of soil on which they are built, for the purpose of predicting performance of structures on the same or similar kinds of soil in other locations.
6. Predict the trafficability of soils for cross-country movement of vehicles and construction equipment.
7. Develop preliminary estimates pertinent to construction in a particular area.

Most of the information in this section is presented in tables 9, 10, and 11. Table 9 (p. 90) shows several estimated soil properties significant to engineering; table 10 (p. 100) gives interpretations for various engineering properties of the soils; and table 11 (p. 130) shows results of engineering laboratory tests on soil samples.

This information, along with the soil map and other

[5] STANLEY O. DINGLE, civil engineer, Soil Conservation Service, helped prepare this section.

TABLE 6.—*Suitability of the*

Wildlife groups and map symbols[1]	Grain and seed crops	Grasses and legumes
Group 1. Moderately well drained to somewhat excessively drained soils that are loamy throughout and are not subject to flooding: AlB, AlC2, AlD2, AmB, AmC2, AmD2, AmE2, AnC2, AnD2, AoA, AoB, ApC2, ApD2, ApF, AsB, AsC2, BpA, FnB, FoB, FoC2, JeA, JeB, JeC2, JsA, JsB OmB, OmC2, OnC2, OnD2, OtB, OtC, OtD2, ReB, ReC2, RgC2, RgD2, SaB, SaC2 ScC2, ScD2, ShA, ShB, ShC2 SlA, SlB, WhB, WhC2, WhD2.	Good where slope is 0 to 6 percent, fair where slope is 6 to 12 percent, poor where slope is more than 12 percent; water erosion is a hazard.	Good where slope is 0 to 12 percent, fair where slope is 12 to 20 percent, poor where slope is more than 20 percent.
Group 2. Moderately well drained silty soils that have a silt loam, clay loam, or silty clay loam subsoil and are not subject to flooding: DeB, DeC2, VaB, VaC2.	Good where slope is 0 to 6 percent, fair where slope is 6 to 12 percent, unsuited where slope is more than 12 percent.	Good where slope is 0 to 12 percent, fair where slope is 12 to 20 percent, unsuited where slope is more than 20 percent.
Group 3. Somewhat excessively drained to excessively drained soils that are sandy throughout and are droughty: BnB, BnC, BnD, EmE, GoB, GoC, HrB, PmB, PmC, PmD.	Fair: water erosion is a hazard.	Good
Group 4. Mainly soils that are thin over sand and gravel or dolomitic limestone and are droughty: BrB, BrC2, BxB, BxC2, BxD2, CoC2, CoD2, CoE, RnB, RnC2, RnD2, RoE.	Fair where slope is 0 to 6 percent, poor where slope is more than 6 percent; water erosion is a hazard.	Good where slope is 0 to 12 percent, fair where slope is 12 to 20 percent, poor where slope is more than 20 percent.
Group 5. Well drained and somewhat excessively drained soils that have a thick dark colored surface layer and are loamy or sandy throughout: DaA, DaB, DcC2, DkB, HeB, HeC2, HeD2, HsB, HsC, NcB, NcC2, NnD2, PlA, PoB, PoC, PoD, RpB, RpC2, RpD2.	Poor where slope is 0 to 6 percent; unsuited where slope is more than 6 percent; droughty; soil blowing is a hazard.	Fair
Group 6. Somewhat poorly drained and moderately well drained soils: DfB, Du, FdA, Fe, HaA, LcA, MaB, OrA, SrA, Ud.	Good where soil has been drained; fair where soil is undrained and wet.	Good where soil has been drained; fair where soil is undrained and wet; few plants are suitable.
Group 7. Very poorly drained and poorly drained soils: AdA, AuA, CyA, Fm, RhA, Se.	Good where soil has been drained; very poor where soil is undrained and wet.	Fair where soil has been drained; poor where soil is undrained and wet.
Group 8. Very poorly drained organic soils: Sm.	Fair where soil has been drained; unsuited where soil is undrained and wet.	Fair where soil has been drained; unsuited where soil is undrained and wet; few plants are suitable.
Group 9. Well drained and moderately well drained silty soils that are subject to flooding: HuA.	Good	Good
Group 10. Well drained shallow soils over limestone and exposures of limestone: RoE.	Poor: water erosion is a hazard; shallow to rock; very low available water capacity.	Poor where slope is more than 20 percent; some plants are not suitable; very low available water capacity.

[1] The following mapping units were not classified in wildlife groups: Cz, Gp.

soils for wildlife habitat

Wild herbaceous upland plants	Woody plants		Wetland plants for food and cover	Shallow and deep water developments
	Hardwood trees and shrubs	Coniferous trees		
Good where slope is 0 to 20 percent, fair where slope is more than 20 percent.	Good where slope is 0 to 20 percent, fair where slope is more than 20 percent.	Good where slope is 0 to 20 percent, fair where slope is more than 20 percent.	Poor where slope is 0 to 2 percent, unsuited where slope is more than 2 percent; few plants are suitable.	Poor where slope is 0 to 2 percent, unsuited where slope is more than 2 percent; moderate permeability.
Good where slope is 0 to 20 percent, fair where slope is more than 20 percent.	Good where slope is 0 to 20 percent, fair where slope is more than 20 percent.	Good where slope is 0 to 20 percent, fair where slope is more than 20 percent.	Unsuited where slope is more than 2 percent; few plants are suitable.	Fair where slope is 2 to 6 percent, poor where slope is 6 to 12 percent; moderately slow or slow permeability in substratum.
Good	Good	Good	Unsuited where slope is more than 2 percent; few plants are suitable.	Unsuited: shallow to very porous substratum.
Good where slope is 0 to 20 percent, fair where slope is more than 20 percent.	Good where slope is 0 to 20 percent, fair where slope is more than 20 percent.	Good where slope is 0 to 20 percent, fair where slope is more than 20 percent.	Unsuited where slope is more than 2 percent; few plants are suitable.	Unsuited: shallow to very porous substratum.
Fair	Fair	Fair	Unsuited	Unsuited.
Fair: wet soil; some plants are not suitable.	Fair: wet soil; some hardwoods are not suitable.	Fair: wet soil; some conifers are not suitable.	Good	Good where slope is 0 to 2 percent; fair where slope is more than 2 percent; wet soil; moderately rapid or rapid permeability in some soils.
Unsuited: very wet soil; few plants are suitable.	Poor: very wet soil; few hardwoods are suitable.	Poor: very wet soil; few conifers are suitable.	Good	Good.
Unsuited: wet soil; few plants are suitable.	Poor: wet soil; some hardwoods are suitable.	Fair: wet soil; some conifers are not suitable.	Good	Good where slope is 0 to 2 percent; fair where slope is more than 2 percent; wet soil.
Good	Fair: flooding is a hazard.	Fair: flooding is a hazard; some conifers are not suitable.	Poor: few plants are suitable.	Poor where slope is 0 to 2 percent; unsuited where slope is more than 2 percent; moderate permeability.
Poor where slope is more than 20 percent; some plants are not suitable; very low available water capacity.	Poor: few hardwoods are suitable; very low available water capacity.	Poor: few conifers are suitable; very low available water capacity.	Unsuited: very low available water capacity; insufficient soil moisture.	Unsuited: shallow to fissured dolomite or gravel.

TABLE 7.—*Relative value of elements of wildlife habitat*

[The numeral 1 means that the element of habitat is of little value for the survival of that kind of wildlife; 2 means that it is of
Dashes mean that the element of habitat

Kinds of wildlife	Grain and seed crops		Grasses and legumes	
	Harvested	Not harvested	Harvested	Not harvested
Migratory waterfowl:				
Ducks	3	3	1	3
Geese	4	5	4	1
Upland game birds:				
Hungarian partridge	4	4	3	4
Pheasant	4	4	----	5
Quail	4	4	2	4
Woodcock	----	----	1	3
Mammals:				
Rabbits, cottontail	3	4	3	5
Raccoon	3	4	----	1
Squirrels, fox and gray	3	4	----	1
Deer	3	4	3	3
Beaver	----	----	----	----
Fox, red[1]	2	3	2	3
Mink[1]	----	----	----	----
Muskrat	1	1	----	----

[1] Some carnivorous animals are not strictly dependent on these elements.

parts of this survey, can be used to make interpretations in addition to those given in tables 9 and 10, and it also can be used to make other useful maps.

This information, however, does not eliminate need for further investigations at sites selected for engineering works, especially works that involve heavy loads or that require excavations to depths greater than those shown in the tables, generally depths greater than 5 feet. Also, inspection of sites, especially the small ones, is needed because many delineated areas of a given soil mapping unit may contain small areas of other kinds of soil that have strongly contrasting properties and different suitabilities or limitations for soil engineering.

Some of the terms used in this soil survey have special meaning to soil scientists. The Glossary defines many of these items commonly used in soil science.

Classification systems

The two systems most commonly used in classifying samples of soils for engineering are the Unified system used by the SCS engineers, Department of Defense, and others, and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO).

The Unified system is used to classify soils according to engineering uses for building material or for the support of structures other than highways (*2*). Soils are classified according to particle size distribution, plasticity index, liquid limit, and organic matter content. Soils are grouped into 15 classes and 11 dual classes. Eight classes of coarse-grained soils are subdivided on the basis of gravel and sand content. These classes are: GW, GP, GM, GC, SW, SP, SM, and SC. Six classes of fine-grained soils are subdivided on the basis of the plasticity index. Nonplastic classes are ML, MH, OL, and OH; plastic classes are CL and CH. There is one class of highly organic soils, Pt. Dual classifications used for a specific range of particle sizes are SP–SM, SW–SM, SP–SC, SW–SC, GP–GM, GW–GM, GP–GC, and GW–GC. For a specific range of liquid limits and plasticity indices, the dual classifications of CL–ML, SC–SM, and GC–GM are used. For borderline cases, usually both possible classifications are listed.

The AASHTO system is used to classify soils according to those properties that affect use in highway construction and maintenance (*1*). In this system, a soil is placed in one of seven basic groups ranging from A–1 through A–7 on the basis of grain-size distribution, liquid limit, and plasticity index. In group A–1 are gravelly soils of high bearing strength, or the best soils for subgrade (foundation). At the other extreme, in group A–7, are clay soils that have low strength when wet and that are the poorest soils for subgrade. Where laboratory data are available to justify a further breakdown, the A–1, A–2, and A–7 groups are divided as follows: A–1–a, A–1–b, A–2–4, A–2–5, A–2–6, A–2–7, A–7–5, and A–7–6. As additional refinement, the engineering value of a soil material can be indicated by a group index number. Group indexes range from 0 for the best material to 20 or more for the poorest. The AASHTO classification for tested soils, with group index numbers in parentheses, is shown in table 11; the estimated classification, without group index numbers, is given in table 9 for all soils mapped in the survey area.

USDA texture is determined by the relative proportions of sand, silt, and clay in soil material that is less

for important species of wildlife in St. Croix County

some value; 3 means that it is important; 4 means that it is very important; and 5 means that it is a critical element of survival. is not suited to that kind of wildlife]

Wild herbaceous upland plants	Woody plants			Wetland plants for food and cover	Shallow water areas	Deep water areas
	Hardwoods		Coniferous trees			
	Shrubs	Trees				
3		1		5	5	4
				2	3	3
4	1			1		
5	4		1	5	3	
4	5	2	1	4	3	
3	4	4	2	3		
5	5	3	1	2	3	
1	2	4		1	5	4
1	2	5	1			
4	4	4	4	3	3	2
	4	5		4	4	5
3	3	2	1	3	3	1
	2	1	1	3	5	5
	1			4	5	5

than 2.0 millimeters in diameter. "Sand," "silt," "clay," and some of the other terms used in the USDA textural classification are defined in the Glossary. Stones, cobbles, and gravel are used as textural modifiers where present in the soil.

Soil properties

Several estimated soil properties significant to engineering are given in table 9. These estimates are made for representative soil profiles by layers that have significantly different soil properties. The estimates are based on field observations made in the course of mapping, on test data for these and similar soils, and on experience with the same kinds of soil in other counties. Following are explanations of some of the columns in table 9.

Depth to bedrock is the distance from the surface of the soil to a rock layer within the depth of observation.

Depth to seasonal high water table is the distance from the surface of the soil to the highest level that ground water reaches in the soil in most years.

Soil texture is described in table 9 in the standard terms used by the Department of Agriculture. These terms are based on the percentages of sand, silt, and clay in the less than 2 millimeter fraction of the soil. "Loam," for example, is soil material that contains 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the soil contains gravel or other particles coarser than sand, an appropriate modifier is added, as for example, "gravelly loamy sand." "Sand," "silt," "clay," and some of the other terms used in USDA textural classification are defined in the Glossary of this soil survey.

Liquid limit and plasticity index are measures of water content obtained by specified operations. As the water content of a clayey soil, from which the particles coarser than 0.5 millimeter have been removed, is increased from a dry state, the material changes from a semisolid to a plastic state. If the moisture content is further increased, the material changes from a plastic to a liquid state. The plastic limit is the moisture content at which the soil material changes from a semisolid to a plastic state; and the liquid limit, from a plastic to a liquid state. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of water content within which a soil material is plastic. Liquid limit and plasticity index are estimated in table 9, but in table 11 the data on liquid limit and plasticity index are based on tests of soil samples.

Permeability, as used here, is an estimate of the rate at which saturated soil would transmit water in a vertical direction under a unit head of pressure. It is estimated on the basis of those soil characteristics observed in the field, particularly structure, porosity, and texture. Lateral seepage or such transient soil features as plowpans and surface crusts are not considered.

Available water capacity is an estimate of the capacity of soils to hold water for use by most plants. It is defined here as the difference between the amount of water in the soil at field capacity and the amount at the wilting point of most plants.

Reaction refers to the acidity or alkalinity of a soil, expressed in pH values for a stated soil-solution mixture. The pH value and terms used to describe soil reaction are explained in the Glossary.

Shrink-swell potential refers to the relative change in volume of soil material to be expected with changes

TABLE 8.—*Recreational limitations*

Recreation groups and map symbols [1]	Playgrounds and intensive play areas	Picnic grounds and extensive play areas
Group 1. Nearly level to very steep, somewhat excessively drained and well drained soils that have a loamy surface layer and mainly moderate or moderately rapid permeability in the subsoil: AlB, AlC2, AlD2, AmB, AmC2, AmD2, AmE2, AnC2, AnD2, AoA, AoB, ApC2, ApD2, ApF, AsB, AsC2, BrB, BrC2, BxB, BxC2, BxD2, CoC2, CoD2, CoE, Cz, DaA, DaB, DcC2, DkB, HeB, HeC2, HeD2, JeA, JeB, JeC2, JsA, JsB, NcB, NcC2, NnD2, OmB, OmC2, OnC2, OnD2, OtB, OtC, OtD2, PlA, PoB, PoC, PoD, RgC2, RgD2, SaB, SaC2, ScC2, ScD2, ShA, ShB, ShC2, SlA, SlB.	Slight where slope is 0 to 2 percent, moderate where slope is 2 to 6 percent, severe where slope is more than 6 percent; erodible slopes; compacts easily when wet; leveling will expose coarse fragments in some soils.	Slight where slope is 0 to 6 percent, moderate where slope is 6 to 12 percent, severe where slope is more than 12 percent; erodible slopes; compacts easily when wet.
Group 2. Nearly level to very steep, excessively drained and somewhat excessively drained soils that have a sandy surface layer and rapid or very rapid permeability in the subsoil: BnB, BnC, BnD, EmE, GoB, GoC, HrB, HsB, HsC, PmB, PmC, PmD.	Moderate where slope is 0 to 6 percent, severe where slope is more than 6 percent; droughtiness; erodible slopes.	Moderate where slope is 0 to 12 percent, severe where slope is more than 12 percent; droughtiness; erodible slopes.
Group 3. Gently sloping to very steep, mostly well drained soils that have a silty surface layer and mainly moderate permeability in the subsoil; depth to dolomite bedrock ranges from surface exposures to a depth of 40 inches: RnB, RnC2, RnD2, RoE, RpB, RpC2, RpD2, WhB, WhC2, WhD2.	Moderate where slope is 2 to 6 percent; permeability is moderately slow or bedrock is within a depth of 20 to 40 inches, or both. Severe where slope is more than 6 percent or bedrock is within a depth of 20 inches.	Slight where slope is 2 to 6 percent, moderate where slope is 6 to 12 percent or where the soil is stony, severe where slope is more than 12 percent or where the soil is more than 50 percent coarse fragments.
Group 4. Gently sloping and sloping, well drained and moderately well drained soils that have a silty surface layer and moderately slow or slow permeability in the subsoil: DeB, DeC2, ReB, ReC2, VaB, VaC2.	Moderate where slope is 2 to 6 percent; moderately slow permeability. Severe where slope is more than 6 percent; erodible slopes.	Slight where slope is 2 to 6 percent, moderate where slope is 6 to 12 percent or where the soil is moderately well drained.
Group 5. Nearly level to sloping, well drained to somewhat poorly drained soils that have a loamy or sandy surface layer and permeability that ranges from rapid to slow in the subsoil; subject to occasional flooding: BpA, DfB, Du, FdA, Fe, FnB, FoB, FoC2, HaA, HuA LcA, MaB, OrA, SrA, Ud.	Moderate where slope is 0 to 6 percent and where the soil is moderately well drained, severe where slope is more than 6 percent or where the soil is somewhat poorly drained; subject to occasional flooding.	Moderate: moderately well drained or somewhat poorly drained; seasonal high perched water table.
Group 6. Nearly level, very poorly drained and poorly drained soils that have a muck, loamy, or sandy surface layer and moderately slow to moderately rapid permeability; subject to flooding and high seasonal water table: AdA, AuA, CyA, Fm, RhA, Se, Sm.	Severe: subject to flooding; low trafficability when wet.	Severe: subject to flooding; low trafficability when wet.

[1] Mapping unit Gp was not classified in the recreational groups.

in moisture content, that is, the extent to which the soil shrinks as it dries out or swells as it gets wet. The extent of shrinking and swelling is influenced by the amount and kind of clay in the soil. Shrinking and swelling of soils may damage building foundations, roads, and other structures. Soils having a *high* shrink-swell potential are the most hazardous.

Shrink-swell is not indicated for organic soils or certain soils which shrink markedly on drying but do not swell quickly when rewetted.

Corrosivity, as used in table 9, pertains to potential soil-induced chemical action that dissolves or weakens steel or concrete. Rate of corrosion of steel is related to soil properties such as drainage, texture, total acidity, and electrical conductivity of the soil material. Installations of steel that intersect soil boundaries or soil horizons are more susceptible to corrosion than installations entirely in one kind of soil or in one soil horizon. Corrosivity for concrete is influenced mainly by the content of sodium or magnesium sulfate, but also by soil texture and acidity. A corrosivity rating of *low* means that there is a low probability of soil induced corrosion damage. A rating of *high* means that there is a high probability of damage, so that protective

of the soils

Camp areas (tent and trailer)	Paths and trails	Golf course fairways
Slight where slope is 0 to 6 percent, moderate where slope is 6 to 12 percent, severe where slope is more than 12 percent; surface slippery and soft when wet; erodible slopes.	Slight where slope is 0 to 12 percent, moderate where slope is 12 to 20 percent, severe where slope is more than 20 percent; erodible slopes; muddy and slippery when wet.	Slight where slope is 0 to 6 percent, moderate where slope is 6 to 12 percent, severe where slope is more than 12 percent; erodible slopes.
Moderate where slope is 0 to 12 percent, severe where slope is more than 12 percent; erodibility; droughtiness; vegetation difficult to maintain.	Moderate where slope is 0 to 20 percent, severe where slope is more than 20 percent; erodibility; poor stability on slopes; paths and trails difficult to maintain; surfacing may be needed.	Moderate where slope is 0 to 12 percent; severe where slope is more than 12 percent; erodibility; droughtiness; good turf difficult to maintain.
Slight where slope is 2 to 6 percent, moderate where slope is 6 to 12 percent or where permeability is moderately slow, severe where slope is more than 12 percent or where the soil is more than 50 percent coarse fragments.	Slight where slope is 2 to 12 percent, moderate where slope is 12 to 20 percent, severe where slope is more than 20 percent or where the soil is more than 50 percent coarse fragments.	Slight where slope is 2 to 6 percent, moderate where slope is 6 to 12 percent or permeability is moderately slow, severe where slope is more than 12 percent or where the soil is more than 50 percent coarse fragments.
Moderate: moderately slow permeability; silty; slippery when wet.	Moderate: moderately slow permeability; slippery when wet.	Moderate: slope is 2 to 12 percent; moderately slow permeability.
Moderate where moderately well drained, severe where somewhat poorly drained; subject to occasional flooding.	Slight where moderately well drained, moderate where somewhat poorly drained; seasonal high perched water table.	Slight where slope is 0 to 6 percent and where the soil is moderately well drained, moderate where slope is 6 to 12 percent or where the soil is somewhat poorly drained; seasonal high perched water table.
Severe: subject to flooding; poor trafficability when wet.	Severe: subject to flooding; poor trafficability when wet.	Severe: subject to flooding; turf easily damaged when wet.

measures for steel and more resistant concrete should be used to reduce damage.

Another soil property significant to engineering use is subsidence. Subsidence is settlement of organic soils when drained or of soils containing semifluid mineral layers. Ratings of soils for subsidence take into account two types of elevation loss: (1) the rapid initial loss of elevation resulting from drainage and lowering the level of the ground water, and (2) the later and slower loss of elevation that results from the oxidation of organic materials. The maximum possible lowering of surface elevation is called potential subsidence. Only the organic soils are subject to subsidence, if drained. These are Seelyeville soils and the Saprists part of Saprists and Aquents. Subsidence of these soils is approximately ½ to 1 inch per year, if drained. A more complete discussion of subsidence is given in the subsection "Basic Practices of Management" where drainage is discussed.

Interpretations of the soils for town and country planning

The estimated interpretations in table 10 (p. 100) are based on the engineering properties of soils shown

TABLE 9.—*Estimated soil properties*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils for referring to other series that appear in the first

Soil series and map symbols	Depth to—		Depth from surface	USDA texture	Classification		Coarse fragment greater than 3 inches
	Bedrock	Seasonal high water table			Unified	AASHTO	
	Ft	*Ft*	*In*				*Pct*
Adolph: AdA	>5	[2,3] 0–1	0–14	Silt loam	CL	A–4, A–6, or A–7	
			14–23	Silt loam	CL	A–4 or A–6	
			23–60	Sandy loam	SM, SC, or SC–SM	A–2 or A–4	0–10
*Amery: AlB, AlC2, AlD2, AmB, AmC2, AmD2, AmE2, AnC2, AnD2. For Cromwell parts of these units, see Cromwell series.	>5	>5	0–12	Loam or sandy loam.	ML, SM, CL–ML, or SM–SC	A–4 or A–2–4	
			12–31	Sandy loam	SC–SM or SM	A–2–4 or A–4	5–10
			31–60	Sandy loam	SC–SM or SM	A–2–4 or A–4	5–10
Antigo: AoA, AoB	>5	>5	0–18	Silt loam	ML, CL, CL–ML	A–4	
			18–29	Silt loam and loam	CL	A–6 or A–7	
			29–33	Sandy loam	SC, SC–SM, or SM	A–2	
			33–60	Sand and gravel	SP, SW, SW–SM, or SP–SM	A–1	0–3
Arland: ApC2, ApD2, ApF	2–3 1/3	>5	0–8	Sandy loam	SM, SC–SM, or SC	A–4	
			8–24	Sandy loam	SM, SC–SM, or SC	A–2 or A–4	10–20
			24–60	Soft sandstone [5]	SP, SP–SM, or SM	A–3 or A–2	10–20
AsB, AsC2	2–3 1/3	>5	0–11	Silt loam	ML, CL–ML, or CL	A–4	0
			11–26	Silt loam and loam	CL–ML or CL	A–4 or A–6	0–10
			26–35	Sandy loam	SM or SC–SM	A–2 or A–4	5–15
			35–60	Soft sandstone [5]	SP or SP–SM	A–3	5–15
Auburndale: AuA	>5	[2,3] 0–1	0–13	Silt loam	ML, CL, or CL–ML	A–4	0
			13–36	Silt loam	CL	A–4 or A–6	0
			36–60	Sandy loam	SC or SC–SM	A–4 or A–6	5–10
Boone: BnB, BnC, BnD	2–3 1/3	>5	0–3	Loamy fine sand	SM	A–2	0
			3–24	Fine sand	SM	A–2	0
			24–60	Soft sandstone and fine sand.[5]	SP, SP–SM, SM	A–3 or A–2	0
Brill: BpA	>5	3–5	0–16	Silt loam	ML, CL–ML, or CL	A–4	0
			16–26	Silt loam	CL	A–6	0
			26–30	Loam	SC or CL	A–4 or A–6	0
			30–60	Sand and gravel	SP	A–1 or A–3	0–10
*Burkhardt: BrB, BrC2, BxB, BxC2, BxD2. For Sattre parts of these units, see Sattre series.	>5	>5	0–12	Sandy loam	SM	A–2–4	0
			12–16	Sandy loam	SM	A–2–4 or A–4	0
			16–60	Sand and gravel	SP or SW	A–1	0–15
Chetek: CoC2, CoD2, CoE. Mapped only in complex with Onamia soils.	>5	>5	0–6	Sandy loam	SM	A–2	0
			6–16	Sandy loam	SM	A–2 or A–4	0
			16–60	Sand and gravel	SP or SW	A–1	0–15

significant to engineering

in such mapping units may have different properties and limitations, and for this reason it is necessary to follow the instructions column of this table. The symbol > means greater than]

Percentage less than 3 inches passing sieve—				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction [1]	Shrink-swell potential	Corrosivity of—	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							Uncoated steel	Concrete
				Pct		*In per hr*	*In per in of soil*	*pH*			
100	95–100	90–100	85–95	30–50	10–25	0.6–2.0	0.22–0.24	5.6–6.0	Low	High	Moderate.
100	95–100	90–100	85–95	20–30	8–15	0.2–0.6	0.20–0.22	6.1–6.5	Moderate	High	Low.
85–95	75–90	55–70	30–40	10–20	2–10	0.2–0.6	0.11–0.13	6.1–7.3	Low	High	Low.
100	100	65–95	30–75	10–30	3–7	0.6–2.0	0.12–0.22	6.6–7.3	Low	Low	Low.
85–100	75–95	70–80	30–45	10–20	2–6	0.6–2.0	0.12–0.14	5.6–7.3	Low	Moderate	High.
85–100	75–95	75–85	30–45	10–20	2–6	0.6–2.0	0.11–0.13	5.6–6.5	Low	Low	High.
100	100	90–100	75–85	20–30	3–10	0.6–2.0	0.22–0.24	5.6–6.0	Low	Low	Moderate.
100	100	80–90	75–85	30–45	15–25	0.6–2.0	0.20–0.22	5.1–5.5	Moderate	Low	Moderate.
85–100	85–95	60–70	25–35	10–20	2–6	2.0–6.0	0.12–0.14	5.1–5.5	Low	Low	High.
75–90	40–85	25–50	2–10	--------	‘NP	>20.0	0.02–0.04	5.1–5.5	Low	Low	High.
95–100	95–100	70–85	40–50	10–20	2–10	2.0–6.0	0.16–0.18	4.5–5.5	Low	Low	High.
85–100	80–95	50–70	25–40	10–20	2–10	2.0–6.0	0.15–0.17	4.5–5.5	Low	Low	High.
95–100	95–100	75–95	3–15	--------	NP	0.6–2.0	0.05–0.07	5.1–6.5	Low	Low	High.
95–100	95–100	80–95	70–80	20–30	3–10	0.6–2.0	0.22–0.24	5.1–7.3	Low	Low	Low.
90–100	80–100	80–95	55–75	25–35	5–15	0.6–2.0	0.17–0.22	5.1–6.0	Low to moderate.	Low	Moderate.
90–100	80–95	50–70	25–40	10–20	1–5	2.0–6.0	0.12–0.14	4.5–5.5	Low	Low	High.
90–100	90–100	75–95	3–10	--------	NP	0.6–2.0	0.05–0.07	5.1–6.5	Low	Low	High.
100	100	100–95	85–95	20–30	2–10	0.6–2.0	0.22–0.24	5.1–6.5	Low	High	Moderate.
100	100	100–95	80–95	20–35	10–20	0.2–0.6	0.20–0.22	4.5–5.5	Moderate	High	High.
85–90	75–95	60–80	35–50	10–20	5–12	0.2–0.6	0.11–0.13	6.1–7.3	Low	High	Low.
100	100	75–90	20–30	--------	NP	>20.0	0.10–0.12	4.5–6.5	Low	Low	High.
100	100	50–90	15–30	--------	NP	>20.0	0.10–0.12	4.5–5.5	Low	Low	High.
90–100	90–100	65–75	3–15	--------	NP	2.0–6.0	0.06–0.10	4.5–5.5	Low	Low	High.
100	100	90–100	70–90	20–30	3–10	0.6–2.0	0.22–0.24	5.6–7.3	Low	Low	Low.
90–100	90–100	80–90	75–85	30–40	15–25	0.6–2.0	0.20–0.22	4.5–5.0	Moderate	Moderate	High.
85–95	85–95	75–85	40–60	20–30	8–15	0.6–2.0	0.17–0.19	5.1–5.5	Low	Moderate	Moderate.
85–90	75–85	35–55	1–5	--------	NP	6.0–20	0.02–0.04	5.6–6.0	Low	Low	Moderate.
95–100	95–100	60–70	25–35	29	NP	2.0–6.0	0.13–0.15	5.1–6.5	Low	Low	High.
95–100	85–95	60–80	30–50	15–25	1–4	2.0–6.0	0.12–0.14	5.1–6.0	Low	Low	High.
75–85	60–75	20–50	1–5	--------	NP	6.0–20	0.02–0.04	5.6–6.5	Low	Low	Moderate.
95–100	95–100	60–70	25–35	>26	NP	2.0–6.0	0.13–0.15	5.1–6.0	Low	Low	High.
95–100	80–95	60–70	30–45	10–22	1–4	2.0–6.0	0.12–0.19	5.1–6.0	Low	Low	High.
75–85	65–85	20–50	1–5	--------	NP	6.0–20	0.02–0.04	5.6–6.5	Low	Low	Moderate.

TABLE 9.—*Estimated soil properties*

Soil series and map symbols	Depth to—		Depth from surface	USDA texture	Classification		Coarse fragment greater than 3 inches
	Bedrock	Seasonal high water table			Unified	AASHTO	
	Ft	*Ft*	*In*				*Pct*
Clyde: CyA	>5	[2,3] 0–1	0–18	Silt loam	CL–ML or CL	A–2 or A–6	0
			18–28	Silt loam	CL	A–6 or A–7	0
			28–60	Heavy loam	CL	A–6	0–5
Cromwell: Mapped only in complex with Amery soils.	>5	>5	0–30	Sandy loam and loamy sand.	SM or SM–SC	A–2 or A–4	0
			30–60	Sand and gravel and loamy sand.	SP, SP–SM, or SM	A–2 or A–3	0–10
Cut and fill areas: Cz. Too variable to be rated.							
*Dakota: DaA, DaB, DcC2. For Pillot part of DcC2, see Pillot series.	>5	>5	0–14	Loam	ML	A–4	0
			14–28	Loam	ML, CL–ML, or CL	A–4 or A–6	0
			28–60	Sand and gravel	SP	A–1 or A–3	0–10
Derinda: DeB, DeC2	1 2/3–3 1/3	[2] 3–5	0–11	Silt loam	CL–ML or CL	A–4 or A–6	0
			11–20	Silt loam	CL	A–6	0
			20–30	Silty clay loam and silty clay.	CH	A–7	0
			30–60	Clay shale			
Derinda Variant: DfB.	1 2/3–3 1/3	[2,3] 1–3	0–18	Silt loam	ML, CL-ML, or CL	A–4	0
			18–40	Silty clay	CH, CL	A–7	0
			40–60	Clay shale			
Dickman: DkB	>5	>5	0–18	Sandy loam	SM	A–2	0
			18–32	Loamy sand	SM	A–2	0
			32–60	Sand and gravel	SP	A–1	0
Duelm: Du	>5	[3] 1–3	0–17	Loamy sand	SM	A–1 or A–2	0
			17–60	Sand	SP	A–1 or A–3	0
Emmert: EmE	>5	>5	0–8	Loamy sand	SM or SC–SM	A–1 or A–2	0–10
			8–60	Sand and gravel	SP, SW, GP, or GW	A–1	0–10
Floyd: FdA	>5	[2,3] 1–3	0–14	Silt loam	CL–ML or CL	A–4 or A–6	0
			14–23	Silt loam	CL	A–6 or A–7	0
			23–42	Loam	CL	A–6	0–5
			42–60	Loam	CL	A–6 or A–7	0–5
Fluvaquents: Fe Too variable to be rated.	>10	[3] 1–3					
Fluvaquents, wet: Fm. Too variable to be rated.	>10	[3] 0–1					
Freeon: FnB	>5	[2] 3–5	0–18	Silt loam	ML	A–4	0
			18–34	Loam	CL or SC	A–4 or A–6	5–10
			34–60	Sandy loam	SM or SC–SM	A–2 or A–4	5–10
FoB, FoC2	>5	[2] 3–5	0–18	Silt loam	ML	A–4	0
			18–50	Loam	CL	A–4 or A–6	5–15
			50–70	Clay loam	CL	A–6 or A–7	0–5

significant to engineering—Continued

Percentage less than 3 inches passing sieve—				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction[1]	Shrink-swell potential	Corrosivity of—	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							Uncoated steel	Concrete
				Pct		*In per hr*	*In per in of soil*	*pH*			
95–100	95–100	85–95	75–85	25–35	5–20	0.6–2.0	0.22–0.24	7.4–7.8	Low	High	Low.
95–100	95–100	90–100	80–90	35–45	15–25	0.2–2.0	0.20–0.22	7.4–7.8	Moderate	High	Low.
90–100	85–95	75–85	55–65	30–40	15–25	0.2–0.6	0.17–0.19	7.4–7.8	Moderate	High	Low.
95–100	75–100	60–90	25–50	10–30	2–5	0.6–2.0	0.11–0.15	5.1–6.0	Low	Low	Moderate.
90–100	70–100	50–75	0–15	>15	NP	6.0–20	0.05–0.07	5.1–6.0	Low	Low	Moderate.
95–100	90–100	85–95	55–65	20–30	1–4	0.6–2.0	0.20–0.22	6.1–6.5	Low	Low	Low.
95–100	90–100	85–95	55–70	20–30	4–15	0.6–2.0	0.17–0.19	5.1–6.5	Low	Low	Moderate.
85–100	80–90	35–65	0–4		NP	6.0–20	0.02–0.04	5.1–6.5	Low	Low	Moderate.
95–100	75–100	85–95	75–85	20–35	4–14	0.2–0.6	0.22–0.24	6.1–6.5	Low	Moderate	Moderate.
95–100	95–100	90–100	80–90	30–40	11–20	0.2–2.0	0.20–0.22	5.6–7.3	Moderate	Moderate	Moderate.
85–100	85–100	95–100	85–100	55–65	30–40	0.6–0.2	0.10–0.12	5.6–7.3	High	High	Low.
								7.4–8.4			
100	100	90–100	70–90	20–30	3–10	0.6–2.0	0.22–0.24	5.6–6.5	Low	High	Moderate.
100	95–100	95–100	90–100	45–65	30–40	0.06–0.20	0.10–0.13	6.6–7.8	High	High	Low.
95–100	95–100	65–75	25–35	10–19	1–4	2.0–6.0	0.12–0.15	5.6–6.0	Low	Low	Moderate.
90–100	90–100	50–70	15–30		NP	6.0–20	0.09–0.11	5.1–6.0	Low	Low	Moderate.
90–100	70–100	25–40	0–4		NP	6.0–20	0.02–0.04	5.6–6.5	Low	Low	Moderate.
95–100	95–100	45–60	15–30		NP	6.0–20	0.10–0.12	6.1–7.3	Low	Low	Moderate.
95–100	95–100	40–60	0–5		NP	6.0–20	0.05–0.07	6.1–7.3	Low	Low	Low.
80–90	65–75	40–55	20–30	16–24	2–5	2–6.0	0.06–0.10	5.1–7.3	Low	Low	Moderate.
50–70	45–60	10–25	0–4		NP	>20.0	0.02–0.04	5.1–7.3	Low	Low	Moderate.
100	100	80–95	75–85	25–35	5–20	0.6–2.0	0.22–0.24	6.6–7.3	Low	High	Low.
95–100	95–100	90–100	80–90	35–45	15–25	0.6–2.0	0.20–0.22	6.6–7.3	Moderate	High	Low.
90–95	85–95	75–85	50–65	30–40	11–20	0.2–0.6	0.17–0.19	6.6–7.8	Moderate	High	Low.
90–95	85–95	85–95	70–80	30–45	15–25	0.2–0.6	0.14–0.16	6.6–7.8	Moderate	High	Low.
100	100	90–95	70–80	20–30	2–4	0.6–2.0	0.22–0.24	6.1–6.5	Low	Moderate	Low.
95–100	75–100	75–85	40–60	15–30	7–15	0.6–2.0	0.17–0.19	5.1–5.5	Moderate	Moderate	Moderate.
95–100	75–95	70–85	25–40	15–20	2–6	0.6–2.0	0.10–0.14	5.1–6.5	Low	Moderate	Moderate.
95–100	95–100	85–95	75–90	20–30	2–4	0.6–2.0	0.22–0.24	5.6–6.0	Low	Moderate	Moderate.
85–100	80–95	75–85	50–65	20–30	10–20	0.6–2.0	0.17–0.19	4.5–5.5	Moderate	Moderate	Moderate.
90–100	85–100	80–95	60–80	35–45	15–25	0.2–0.6	0.14–0.16	5.6–6.0	Moderate	High	Moderate.

TABLE 9.—*Estimated soil properties*

Soil series and map symbols	Depth to—		Depth from surface	USDA texture	Classification		Coarse fragment greater than 3 inches
	Bedrock	Seasonal high water table			Unified	AASHTO	
	Ft	*Ft*	*In*				*Pct*
Gotham: GoB, GoC--	>5	>5	0–30	Loamy fine sand	SM	A–2	0
			30–60	Fine sand with loamy bands.	SP, SP–SM, or SM	A–2 or A–3	0
Gravel pits: Gp. Too variable to be rated.							
Halder: HaA	>5	[3] 1–3	0–21	Silt loam	CL–ML or CL	A–4	0
			21–28	Sand clay loam	SC or CL	A–6	0
			28–60	Sand and gravel	SP, SP–SM, or SM	A–2 or A–3	0–5
Hesch: HeB, HeC2, HeD2.	>5	>5	0–19	Fine sandy loam	SM	A–4, A–2	0
			19–34	Fine sandy loam	SC–SM or SC	A–4	0
			34–54	Fine sandy loam	SM	A–4	0
			54–60	Fine sand [5]	SP–SM or SM	A–2	0
Hubbard: HrB	>5	>5	0–18	Loamy sand	SM or SC–SM	A–2	0
			18–60	Sand	SP	A–3	0
Hubbard, loamy substratum: HsB, HsC.	>5	>5	0–46	Loamy sand	SM	A–2	0
			46–60	Silt loam	ML or CL	A–4 or A–6	0
Huntsville: HuA	>5	[3] 3–5	0–44	Silt loam	ML or CL	A–4, A–5, A–6, or A–7	0
			44–55	Loam	ML, CL–ML, or CL	A–4	0
			55–60	Sandy loam	SM	A–2 or A–4	0
Jewett: JeA, JeB, JeC2	>5	>5	0–19	Silt loam	ML, CL–ML, or CL	A–4	0
			19–26	Loam	CL, CL–ML, SC, or SC–SM	A–4 or A–6	5–10
			26–60	Sandy loam	SM or SC–SM	A–2	5–10
JsA, JsB	>5	>5	0–16	Silt loam	ML, CL–ML, or CL	A–4	0
			16–23	Loam	CL, CL–ML, SC, or SC–SM	A–4 or A–6	5–15
			23–46	Sandy loam	SC, SC–SM, or SM	A–2	5–15
			46–60	Sand and gravel	SP	A–1 or A–3	0–10
Lawler: LcA	>5	[3] 1–3	0–29	Silt loam	ML or CL	A–4, A–5, A–6, or A–7	0
			29–39	Sandy loam and loam.	SC or CL	A–4, A–6	0–5
			39–60	Sand and gravel	SP or SP–SM	A–1 or A–3	0–10
Magnor: MaB	>5	[3,4] 1–3	0–18	Silt loam	ML	A–4	0
			18–25	Loam	SC or CL	A–4 or A–6	0–10
			25–60	Sandy loam	SM, SC–SM, or SC	A–4 or A–2	0–10
Nickin: NcB, NcC2, NnD2.	>5	>5	0–11	Silt loam or loam	ML	A–4	0
			11–23	Silt loam	ML, CL–ML, or CL	A–4 or A–6	0
			23–29	Loam	CL	A–4 or A–6	0–10
			29–34	Sandy loam	SC, SC–SM, or SM	A–4 or A–2	0
			34–60	Fine sand [5]	SP, SP–SM, or SM	A–3 or A–2	0

significant to engineering—Continued

Percentage less than 3 inches passing sieve—				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction [1]	Shrink-swell potential	Corrosivity of—	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							Uncoated steel	Concrete
				Pct		*In per hr*	*In per in of soil*	*pH*			
100	100	80–95	15–25	--------	NP	6.0–20	0.09–0.12	5.1–6.0	Low	Low	High.
100	100	60–95	3–20	--------	NP	6.0–20	0.07–0.12	5.6–6.5	Low	Low	Moderate.
100	95–100	85–95	75–85	20–30	5–10	0.6–2.0	0.22–0.24	5.1–6.0	Low	High	Moderate.
95–100	85–100	80–95	40–70	25–35	11–20	0.6–2.0	0.16–0.18	5.1–5.5	Low	High	Moderate.
80–100	75–95	50–70	3–20	--------	NP	6.0–20	0.05–0.10	5.6–6.5	Low	Moderate	Moderate.
100	100	70–85	30–50	10–20	2–4	2.0–6.0	0.16–0.18	5.6–6.0	Low	Low	Moderate.
100	100	70–85	40–50	15–25	4–10	2.0–6.0	0.15–0.17	5.1–5.5	Low	Low	High.
100	100	70–85	40–50	10–20	2–4	0.6–2.0	0.14–0.16	4.5–5.5	Low	Low	High.
100	100	65–80	10–30	--------	NP	0.6–2.0	0.05–0.07	4.5–5.5	Low	Low	High.
95–100	95–100	70–90	15–25	14–23	2–5	6.0–20	0.10–0.12	5.1–6.0	Low	Low	High.
90–100	85–100	50–70	2–5	--------	NP	6.0–20	0.05–0.07	5.1–6.5	Low	Low	High.
100	95–100	50–75	15–30	--------	NP	6.0–20	0.09–0.11	5.1–6.0	Low	Low	Moderate.
100	90–100	85–95	75–85	25–35	2–15	0.2–2.0	0.11–0.22	5.6–6.5	Low	Moderate	Moderate.
100	98–100	90–100	80–100	36–50	10–25	0.6–2.0	0.22–0.24	6.1–7.8	Low	Low	Low.
95–100	90–100	80–90	60–75	18–30	2–8	0.6–2.0	0.17–0.19	6.1–7.8	Low	Moderate	Low.
90–100	80–100	60–70	30–40	10–20	NP	0.6–2.0	0.11–0.13	7.4–7.8	Low	Moderate	Low.
100	100	90–100	80–90	20–30	3–10	0.6–2.0	0.22–0.24	5.1–7.3	Low	Low	Low.
85–100	85–100	75–85	40–65	20–35	5–20	0.6–2.0	0.17–0.19	5.1–6.0	Moderate	Low	Moderate.
85–100	80–95	65–80	25–35	10–20	2–7	0.6–2.0	0.08–0.10	5.1–6.5	Low	Low	Moderate.
100	100	90–100	80–90	20–30	3–10	0.6–2.0	0.22–0.24	5.1–7.3	Low	Low	Low.
85–95	85–95	75–85	40–65	20–30	5–20	0.6–2.0	0.17–0.19	5.1–6.0	Moderate	Low	Moderate.
80–90	75–90	45–65	25–35	10–20	2–10	2.0–6.0	0.08–0.10	5.1–6.5	Low	Low	Moderate.
70–90	65–90	35–60	0–5	--------	NP	6.0–20	0.02–0.04	5.1–6.0	Low	Low	High.
100	95–100	85–95	65–75	35–45	10–25	0.6–2.0	0.20–0.22	5.6–7.3	Low	High	Low.
85–95	80–95	70–85	45–65	25–35	8–15	0.6–2.0	0.16–0.18	5.6–6.5	Low	Moderate	Low.
80–90	60–85	35–60	2–10	--------	NP	6.0–20	0.02–0.04	6.1–7.3	Low	Low	Low.
100	95–100	90–100	80–90	20–30	1–3	0.6–2.0	0.22–0.24	5.1–5.5	Low	High	Moderate.
90–100	85–95	65–80	35–60	20–35	10–20	0.2–0.6	0.17–0.19	5.1–5.5	Moderate	High	Moderate.
90–100	85–95	60–70	30–45	15–30	3–10	0.2–0.6	0.11–0.13	5.6–6.0	Low	Moderate	Moderate.
100	100	85–100	60–85	20–30	1–5	0.6–2.0	0.22–0.24	5.6–7.3	Low	Low	Moderate.
100	100	90–100	70–85	20–40	5–20	0.6–2.0	0.17–0.22	5.1–6.5	Low	Low	Moderate.
75–100	75–100	85–95	50–60	25–35	10–20	0.6–2.0	0.17–0.19	5.1–6.5	Low	Moderate	Moderate.
95–100	80–90	55–70	30–40	10–20	2–10	0.6–2.0	0.12–0.14	5.1–6.5	Low	Moderate	High.
100	100	95–100	3–15	--------	NP	2.0–6.0	0.05–0.07	5.6–6.0	Low	Low	High.

TABLE 9.—*Estimated soil properties*

Soil series and map symbols	Depth to—		Depth from surface	USDA texture	Classification		Coarse fragment greater than 3 inches
	Bedrock	Seasonal high water table			Unified	AASHTO	
	Ft	*Ft*	*In*				*Pct*
*Onamia: OmB, OmC2, OnC2, OnD2. For Antigo parts of these units, see Antigo series.	>5	>5	0–7	Loam	CL–ML, CL	A–4	0
			7–28	Loam	SC or CL	A–4 or A–6	0
			28–32	Sandy loam	SM or SC–SM	A–2 or A–4	0
			32–60	Sand and gravel	SP or SP–SM	A–1 or A–3	0–10
Orion: OrA	>5	[3] 1–3	0–60	Silt loam	ML or CL–ML	A–4	0
Otterholt: OtB, OtC, OtD2.	>5	>5	0–16	Silt loam	CL–ML or CL	A–4	0
			16–45	Silt loam	CL	A–4 or A–6	0
			45–60	Silt loam	CL–ML or CL	A–4 or A–6	0
Pillot: PlA	>5	>5	0–15	Silt loam	CL–ML or CL	A–4 or A–6	0
			15–37	Silt loam	CL	A–6 or A–7	0
			37–60	Sand and gravel	SP	A–1 or A–3	0–5
Plainfield: PmB, PmC, PmD.	>5	>5	0–8	Loamy sand	SM	A–2	0
			8–60	Sand	SP	A–3	0
Port Byron: PoB, PoC, PoD.	>5	>5	0–60	Silt loam	CL	A–4 or A–6	0
Renova: ReB, ReC2	>5	>5	0–9	Silt loam	ML	A–4	0
			9–17	Silt loam	CL	A–6	0
			17–60	Heavy loam	CL	A–6	0–5
Renova Variant: RqC2, RgD2.	>5	>5	0–6	Loam	ML	A–4	0
			6–15	Sandy loam	SC or CL	A–4 or A–6	0–5
			15–34	Loam	CL	A–4 or A–6	0–10
			34–60	Sandy loam and loamy sand.	SM	A–2	0–10
Rib: RhA	>5	[3] 0–1	0–14	Silt loam	ML, CL–ML, or CL	A–4	0
			14–25	Silt loam	CL	A–4 or A–6	0
			25–30	Loam	ML or CL	A–4	0
			30–60	Sand and gravel	SP or SP–SM	A–1 or A–3	0–3
Ritchey: RnB, RnC2, RnD2, RoE.	5/6–1 2/3	>5	0–10	Silt loam	CL–ML or CL	A–4 or A–6	0–10
			10–18	Loam	CL	A–6 or A–4	0–20
			18	Limestone			
Rockton: RpB, RpC2, RpD2.	1 2/3–3 1/3	>5	0–14	Silt loam	CL–ML or CL	A–4	0
			14–26	Silt loam	CL	A–6	0
			26–38	Sandy loam	SC	A–2, A–4, or A–6	0–5
			38	Limestone			
*Santiago: SaB, SaC2, ScC2, ScD2. For Antigo parts of these units, see Antigo series.	>5	>5	0–20	Silt loam	CL–ML or CL	A–4	0
			20–30	Loam	SC or CL	A–4 or A–6	0–10
			30–60	Sandy loam	SC or SC–SM	A–2, A–4, or A–6	0–10
Saprists and Aquents: Se. Most data too variable to be rated.	>5	0–1					

significant to engineering—Continued

Percentage less than 3 inches passing sieve—				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction [1]	Shrink-swell potential	Corrosivity of—	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							Uncoated steel	Concrete
				Pct		*In per hr*	*In per in of soil*	*pH*			
95–100	90–95	80–90	50–70	20–30	5–10	0.6–2.0	0.20–0.22	5.6–6.5	Low	Low	Moderate.
90–100	85–95	60–90	40–75	20–35	8–16	0.6–2.0	0.16–0.18	4.5–6.0	Low	Low	High.
85–95	80–90	60–70	30–40	20–29	2–6	2.0–6.0	0.12–0.14	4.5–6.0	Low	Low	High.
70–90	65–80	35–60	1–6		NP	6.0–20	0.02–0.04	5.6–6.5	Low	Low	Moderate.
100	100	80–90	70–90	25–35	2–10	0.6–2.0	0.20–0.22	6.1–7.8	Low	Moderate	Low.
100	100	90–100	85–95	20–30	5–10	0.6–2.0	0.22–0.24	6.1–6.5	Low	Low	Low.
100	100	95–100	80–95	25–35	10–20	0.6–2.0	0.20–0.22	4.5–5.5	Moderate	Low	Moderate to high.
100	100	90–100	85–95	25–35	5–15	0.6–2.0	0.20–0.22	5.6–6.5	Low	Low	Moderate.
100	100	85–95	75–85	23–35	4–15	0.6–2.0	0.22–0.24	6.1–7.3	Low	Low	Low.
100	100	85–95	80–90	25–45	11–20	0.6–2.0	0.20–0.22	5.1–6.5	Moderate	Low	Moderate.
75–100	75–100	35–65	0–5		NP	6.0–20	0.02–0.04	5.6–6.5	Low	Low	Moderate.
100	100	60–80	15–30		NP	6.0–20	0.10–0.12	5.6–6.5	Low	Low	Moderate.
100	100	55–65	1–4		NP	6.0–20	0.06–0.08	5.6–6.5	Low	Low	Moderate.
100	100	95–100	95–100	26–37	7–18	0.6–2.0	0.22–0.24	5.1–6.5	Low	Low	Moderate.
95–100	95–100	85–95	75–90	20–30	1–4	0.6–2.0	0.22–0.24	5.6–6.5	Low	Low	Moderate.
95–100	95–100	90–100	80–90	25–35	12–20	0.2–0.6	0.20–0.22	4.1–5.5	Moderate	Moderate	Moderate.
85–95	80–90	70–85	55–70	20–35	12–20	0.2–0.6	0.17–0.19	4.1–7.8	Moderate	Moderate	Moderate to low.
95–100	95–100	85–95	60–75	20–30	1–4	0.6–2.0	0.20–0.22	5.6–6.0	Low	Low	Moderate.
95–100	90–100	70–85	40–60	20–30	8–15	0.6–2.0	0.12–0.19	4.5–6.0	Low	Low	High.
85–100	85–100	85–95	60–80	20–35	8–15	0.6–2.0	0.15–0.19	4.5–6.0	Moderate	Low	High.
80–95	75–95	50–65	15–35	>20	NP–4	0.6–6.0	0.08–0.13	5.6–6.5	Low	Low	Moderate.
100	100	90–100	75–85	20–30	3–10	0.6–2.0	0.22–0.24	5.1–6.5	Low	High	Moderate.
100	100	85–95	75–85	20–35	8–20	0.6–2.0	0.18–0.22	5.1–6.5	Moderate	High	Moderate.
85–100	85–95	75–85	55–65	20–30	5–10	0.6–2.0	0.17–0.19	5.6–7.3	Low	High	Moderate.
80–90	70–80	45–55	2–10		NP	6.0–20	0.02–0.04	6.6–7.8	Low	High	Moderate.
95–100	95–100	90–100	75–85	22–35	4–12	0.6–2.0	0.22–0.24	5.6–6.5	Low	Low	Moderate to low.
85–100	85–95	75–85	55–75	30–40	8–18	0.6–2.0	0.17–0.19	6.1–7.3	Low	Low	Low.
95–100	95–100	85–95	75–85	20–30	4–10	0.6–2.0	0.22–0.24	5.6–6.5	Low	Low	Moderate.
95–100	95–100	85–95	75–85	30–40	11–20	0.6–2.0	0.20–0.22	4.5–5.5	Moderate	Moderate	Moderate to high.
85–100	75–90	50–70	25–40	15–30	7–15	0.6–2.0	0.15–0.17	5.1–8.4	Low	Low	Low to moderate.
95–100	95–100	90–100	70–90	20–30	4–10	0.6–2.0	0.22–0.24	5.6–6.5	Moderate	Moderate	Moderate.
90–100	75–95	70–85	36–55	20–30	8–15	0.6–2.0	0.17–0.19	5.1–5.5	Low	Low	Moderate.
80–100	75–95	70–85	30–50	20–30	6–15	0.6–2.0	0.11–0.13	5.1–6.0	Low	Low	High.

TABLE 9.—*Estimated soil properties*

Soil series and map symbols	Depth to—		Depth from surface	USDA texture	Classification		Coarse fragment greater than 3 inches
	Bedrock	Seasonal high water table			Unified	AASHTO	
	Ft	*Ft*	*In*				*Pct*
Sattre: ShA, ShB, ShC2, SlA, SlB.	>5	>5	0–17	Silt loam or loam	ML	A–4	0
			17–30	Loam	SC–SM, SC, CL–ML, or CL	A–4 or A–6	0
			30–60	Sand and gravel	SP	A–1 or A–3	0–5
Seelyeville: Sm	>5	[2,3] 1–3	0–55	Muck	Pt		0
			55–60	Sand	SP, SP–SM, or SM	A–2 or A–3	0
Skyberg: SrA	>5	[2,3] 0–1	0–18	Silt loam	ML or CL	A–4 or A–6	0
			18–32	Heavy loam	CL	A–6 or A–7	0–5
			32–60	Heavy loam	CL	A–6	0–5
Udifluvents: Ud Too variable to be rated.	>5	[3] 2–5					
Vlasaty: VaB, VaC2	>5	[3] 3–5	0–16	Silt loam	CL–ML or CL	A–4 or A–6	0
			16–42	Clay loam	CL	A–6	0–5
			42–60	Clay loam	CL	A–6 or A–7	0–5
Whalan: WhB, WhC2, WhD2.	1 2/3–3 1/3	>5	0–20	Silt loam	CL–ML or CL	A–4	0
			20–30	Loam	SC or CL	A–6	0–10
			30–34	Clay loam	CL	A–6 or A–7	0–5
			34	Limestone			

[1] In many areas the pH value of the surface layer is higher than the value given because of liming practices used in farming.
[2] Seasonally perched high water table.
[3] Soils are subject to flooding, ponding or occasional overflow of short duration.

in table 9, on test data for soils in this survey area and others nearby or adjoining, and on the experience of engineers and soil scientists with the soils of St. Croix County. In table 10, ratings are used to summarize limitation or suitability of the soils and lists those soil features not to be overlooked in planning, installation, and maintenance.

Soil limitations are indicated by the ratings *slight*, *moderate*, and *severe*. *Slight* means soil properties generally are favorable for the rated use, or in other words, limitations are minor and easily overcome. *Moderate* means that some soil properties are unfavorable but can be overcome or modified by special planning and design. *Severe* means soil properties so unfavorable and so difficult to correct or overcome as to require major soil reclamation, special designs, or intensive maintenance. For some uses, the rating of severe is divided into ratings of severe and very severe.

Soil suitability is rated by the terms *good*, *fair*, and *poor*, which have, respectively, meaning approximately parallel to the terms *slight*, *moderate*, and *severe*.

Following are explanations of some of the columns in table 10.

Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into natural soil. The soil material between depths of 18 inches and 6 feet is evaluated. The soil properties considered are those that affect both absorption of effluent and construction and operation of the system. Properties that affect absorption are permeability, depth to water table or rock, and susceptibility to flooding. Slope, the risk of erosion, lateral seepage, and flow of effluent downslope are soil properties that affect difficulty of layout and construction. Large rocks or boulders increase construction costs (*5*).

Sewage lagoons are shallow ponds constructed to hold sewage within a depth of 2 to 5 feet while bacteria decompose the solids. A lagoon has a nearly level floor and sides, or embankments, of compacted soil material. The assumption is made that the embankment is compacted to medium density and the pond is protected from flooding. Properties that affect the pond floor are

significant to engineering—Continued

Percentage less than 3 inches passing sieve—				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction [1]	Shrink-swell potential	Corrosivity of—	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							Uncoated steel	Concrete
				Pct		*In per hr*	*In per in of soil*	*pH*			
95–100	95–100	85–95	75–85	25–35	2–8	0.6–2.0	0.22–0.24	5.1–6.0	Low	Low	Moderate.
85–95	80–95	70–85	40–60	20–30	5–15	0.6–2.0	0.15–0.17	5.1–6.0	Low	Low	Moderate.
80–100	75–85	35–65	0–5		NP	6.0–20	0.02–0.05	5.6–6.0	Low	Low	Moderate.
						2.0–6.0	0.25–0.35	5.6–6.5		Moderate	Moderate.
95–100	95–100	50–70	4–15		NP	6.0–20	0.02–0.04	5.6–7.3	Low	Moderate	Low.
100	100	90–100	85–95	30–40	6–15	0.6–2.0	0.22–0.24	4.5–6.0	Moderate	High	High to moderate.
95–100	90–100	80–95	55–75	30–45	15–25	0.2–0.6	0.18–0.20	4.5–5.5	Moderate	High	High to moderate.
95–100	90–100	85–95	60–75	30–40	15–25	0.2–0.6	0.18–0.20	6.1–7.3	Moderate	High	Low.
100	100	95–100	85–95	25–35	5–15	0.6–2.0	0.22–0.24	5.6–6.5	Low	Moderate	Low to high.
95–100	90–100	85–95	55–70	30–40	11–25	0.2–0.6	0.14–0.16	4.5–5.5	Moderate	High	High.
95–100	90–100	85–95	55–70	35–45	15–30	0.2–0.6	0.14–0.16	7.4–8.4	Moderate	High	Low.
100	100	90–100	80–90	20–30	5–10	0.6–2.0	0.22–0.24	4.5–6.5	Low	Low	Moderate.
75–95	75–95	65–85	40–60	25–35	11–20	0.6–2.0	0.17–0.19	4.5–6.0	Low	Low	Moderate to high.
95–100	85–95	80–95	60–75	35–45	15–30	0.2–0.6	0.15–0.19	5.6–6.0	Moderate	Moderate	Moderate.

[1] NP means nonplastic.
[2] Soft sandstone (weakly cemented) parting to loose sand when dug with spade but in a few places strongly cemented bedrock is at depths ranging from 4 to 6 feet.

permeability, organic matter, and slope; and if the floor needs to be leveled, depth to bedrock becomes important. The soil properties that affect the embankment are the engineering properties of the embankment material as interpreted from the Unified Soil Classification and the amount of stones, if any, that influence the ease of excavation and compaction of the embankment material.

Shallow excavations are those that require digging or trenching to a depth of less than 6 feet, as for example, excavations for pipelines, sewer lines, phone and power transmission lines, basements, open ditches, and cemetery plots. Desirable soil properties are good workability, moderate resistance to sloughing, gentle slopes, absence of rock outcrops or big stones, and freedom from flooding or a high water table.

Dwellings, as rated in table 10, are not more than three stories high and are supported by foundation footings placed in undisturbed soil. The features that affect the rating of a soil for dwellings are those that relate to capacity to support load and resist settlement under load, and those that relate to ease of excavation. Soil properties that affect capacity to support load are wetness, susceptibility to flooding, density, plasticity, texture, and shrink-swell potential. Those that affect excavation are wetness, slope, depth to bedrock, and content of stones and rocks.

Sanitary landfill is a method of disposing of refuse in dug trenches. The waste is spread in thin layers, compacted, and covered with soil throughout the disposal period. Landfill areas are subject to heavy vehicular traffic. Some soil properties that affect suitability for landfill are ease of excavation, hazard of polluting ground water, and trafficability. The best soils have moderately slow permeability, withstand heavy traffic, and are friable and easy to excavate. Unless otherwise stated the ratings in table 10 apply only to a depth of about 5 feet, and ratings of *slight* or *moderate* may not be valid if trenches are to be much deeper than that. For some soils, reliable predictions can be made to a depth of 10 or 15 feet, but regardless of that, every site should be investigated before it is selected for a landfill.

Local roads and streets, as rated in table 10, have an

TABLE 10.—*Interpretations of*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. fully the instructions for referring to other series

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with basements	Trench type sanitary landfill [1]	Local roads and streets
Adolph: AdA	Severe: high water table; floods.	Severe: high water table.	Severe: high water table; floods.	Severe: high water table; floods.	Severe: high water table; floods.	Severe: high water table; susceptible to frost action; floods.
*Amery: AlB, AmB	Moderate: moderate permeability.	Moderate: moderate permeability; slope.	Slight	Slight	Slight	Moderate: susceptible to frost action; low shear strength.
AlC2, AmC2, AnC2 For Cromwell part of AnC2, see Cromwell series.	Moderate: moderate permeability; slope.	Severe: slope	Moderate: slope.	Moderate: slope.	Slight	Moderate: slope; susceptible to frost action; low shear strength.
AlD2, AmD2, AmE2, AnD2. For Cromwell part of AnD2, see Cromwell series.	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Moderate where slope is 12 to 20 percent; severe where slope is more than 20 percent.	Severe: slope
Antigo: AoA, AoB	Slight [3]	Severe: very rapid permeability in substratum.	Severe: sidewall instability of substratum.	Slight	Severe: very rapid permeability in substratum.	Moderate: susceptible to frost action; low shear strength in upper part of soil.
Arland: AsB	Moderate: sandstone bedrock at 24 to 40 inch depth. [5]	Severe: sandstone bedrock at 24 to 40 inch depth; slope; moderate permeability.	Moderate: sandstone bedrock at 24 to 40 inch depth. [6]	Moderate: sandstone bedrock at 24 to 40 inch depth.	Severe: seepage possible in substratum; sandstone bedrock at 24 to 40 inch depth.	Slight
ApC2, AsC2	Moderate: sandstone bedrock at 24 to 40 inch depth; slope. [5]	Severe: sandstone bedrock at 24 to 40 inch depth; slope; moderate permeability.	Moderate: sandstone bedrock at 24 to 40 inch depth. [6]	Moderate: sandstone bedrock at 24 to 40 inch depth; slope.	Severe: seepage possible in substratum; sandstone bedrock at 24 to 40 inch depth.	Moderate: slope.
ApD2	Severe: slope	Severe: sandstone bedrock at 24 to 40 inch depth; [6] slope; moderate permeability.	Severe: slope	Severe: slope	Severe: seepage possible in substratum; sandstone bedrock at 24 to 40 inch depth.	Severe: slope

engineering properties of the soils

The soils in such mapping units may have different properties and limitations, and for this reason it is necessary to follow care-
that appear in the first column of this table]

Suitability as source of—			Soil features affecting—				
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Dikes, levees, and other embankments	Drainage for crops and pasture	Irrigation	Terraces and diversions
Poor: high water table; susceptible to frost action.	Unsuited	Poor: high water table.	Moderately slow permeability; high water table; floods.	Piping hazard	Very poorly drained; floods.	High available water capacity; high water table; floods.	Slopes are 0 to 3 percent; high water table; some stones; floods.
Fair: susceptible to frost action.	Poor: fines [3]	Good	Moderate permeability.	Medium to low shear strength.	Natural drainage is adequate.	Moderate available water capacity; moderately rapid water intake rate.	Slopes are 2 to 6 percent; small stones; sandy loams have hazard of soil blowing.
Fair: susceptible to frost action.	Poor: fines [3]	Fair: slope	Moderate permeability.	Medium to low shear strength.	Natural drainage is adequate.	Moderate available water capacity; moderately rapid water intake rate; slope.	Slopes are 6 to 12 percent; small stones; sandy loams have hazard of soil blowing.
Fair where slope is 12 to 20 percent; poor where slope is more than 20 percent; susceptible to frost action.	Poor: fines [3]	Poor: slope	Moderate permeability; slope.	Medium to low shear strength.	Natural drainage is adequate	Moderate available water capacity; moderately rapid water intake rate; slope.	Slopes are 12 to 30 percent; small stones; sandy loams have hazard of soil blowing.
Fair: susceptible to frost action; low shear strength in upper part of soil. [4]	Good	Good	Very rapid permeability in substratum.	Low shear strength; high permeability of compacted material.	Natural drainage is adequate.	Moderate available water capacity; moderate water intake rate.	Slopes are 0 to 6 percent; sand and gravel substratum at 20 to 40 inches.
Fair: borrow area difficult to vegetate.	Poor: excess fines.	Good	Moderate permeability; sandstone bedrock at 24 to 40 inch depth.	Medium to low shear strength; thin layer.	Natural drainage is adequate.	Moderate available water capacity; moderate water intake rate.	Slopes are 2 to 6 percent; sandstone bedrock at 24 to 40 inch depth.
Fair: borrow area difficult to vegetate.	Poor: excess fines.	Fair: slope	Moderate permeability; sandstone bedrock at 24 to 40 inch depth; slope.	Medium to low shear strength; thin layer.	Natural drainage is adequate.	Moderate available water capacity; slope.	Slopes are 6 to 12 percent; sandstone bedrock at 24 to 40 inch depth.
Fair: slope	Poor: excess fines.	Poor: slope	Moderate permeability; sandstone bedrock at 24 to 40 inch depth; slope.	Medium to low shear strength; thin layer.	Natural drainage is adequate.	Moderate available water capacity; slope.	Slopes are 12 to 25 percent; sandstone bedrock at 24 to 40 inch depth.

TABLE 10.—*Interpretations of engineering*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with basements	Trench type sanitary landfill [1]	Local roads and streets
Arland—cont: ApF	Severe: slope	Severe: sandstone bedrock at 24 to 40 inch depth; [6] slope; moderate permeability.	Severe: slope	Severe: slope	Severe: slope	Severe: slope
Auburndale: AuA	Severe: high water table; floods.	Severe: high water table; floods.	Severe: high water table; floods.	Severe: high water table; floods.	Severe: high water table; floods.	Severe: high water table; floods; susceptible to frost action.
Boone: BnB	Moderate: sandstone bedrock at 24 to 40 inch depth. [6]	Severe: very rapid permeability; sandstone bedrock at 24 to 40 inch depth. [6]	Severe: sidewall instability. [6]	Moderate: sandstone bedrock at 24 to 40 inch depth. [6]	Severe: very rapid permeability; sandstone bedrock at 24 to 40 inch depth. [6]	Slight [6]
BnC	Moderate: sandstone bedrock at 24 to 40 inch depth; slope. [6]	Severe: very rapid permeability; sandstone bedrock at 24 to 40 inch depth. [6]	Severe: sidewall instability. [6]	Moderate: sandstone bedrock at 24 to 40 inch depth; slope.	Severe: very rapid permeability; sandstone bedrock at 24 to 40 inch depth. [6]	Moderate: slope. [6]
BnD	Severe: slope [6]	Severe: very rapid permeability; slope; sandstone bedrock at 24 to 40 inch depth.	Severe: sidewall instability; slope. [6]	Severe: slope. [6]	Severe: very rapid permeability; sandstone bedrock at 24 to 40 inch depth. [6]	Severe: slope. [6]
Brill: BpA	Severe: seasonal high water table. [5]	Severe: rapid permeability in substratum.	Severe: sidewall instability of substratum.	Moderate: seasonal high water table.	Severe: rapid permeability in the substratum.	Severe: susceptible to frost action; low shear strength.

properties of the soils—Continued

Suitability as source of—			Soil features affecting—				
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Dikes, levees, and other embankments	Drainage for crops and pasture	Irrigation	Terraces and diversions
Poor: slope	Poor: excess fines.	Poor: slope	Moderate permeability; sandstone bedrock at 24 to 40 inch depth; slope.	Medium to low shear strength; thin layer.	Natural drainage is adequate.	Moderate available water capacity; slope.	Slopes are 25 to 35 percent; stones common; sandstone bedrock at 24 to 40 inch depth.
Poor: high water table; susceptible to frost action.	Unsuited	Poor: high water table.	Moderately slow permeability; high water table; floods.	Medium to low permeability of compacted material; piping hazard.	Poorly drained; moderately slow permeability; floods.	High available water capacity; high water table; floods.	Slopes are 0 to 3 percent; high water table; floods.
Good for sand.[e] Poor for gravel.	Good [e]	Poor: sandy	Very rapid permeability; sandstone bedrock at 24 to 40 inch depth.	High permeability of compacted material; high permeability; medium to high piping hazard.[e]	Excessively drained.	Low available water capacity; rapid water intake rate; soil blowing hazard.	Slopes are 2 to 6 percent; sandy; difficult to vegetate and stabilize; soil blowing hazard; sandstone bedrock at 24 to 40 inch depth.[e]
Good for sand.[e] Poor for gravel.	Good [e]	Poor: sandy	Very rapid permeability; sandstone bedrock at 24 to 40 inch depth; slope.[e]	High permeability of compacted material; medium to high piping hazard.[e]	Excessively drained.	Low available water capacity; rapid water intake rate; soil blowing hazard; slope.	Slopes are 6 to 12 percent; sandy; difficult to vegetate and stabilize; soil blowing hazard; sandstone bedrock at 24 to 40 inch depth.[e]
Fair: slope [e]	Good [e]	Poor: sandy; slope.	Very rapid permeability; sandstone bedrock at 24 to 40 inch depth; slope.[e]	High permeability of compacted material; medium to high piping hazard.[e]	Excessively drained.	Low available water capacity; rapid water intake rate; soil blowing hazard; slope.	Slopes are 12 to 20 percent; sandy; difficult to vegetate and stabilize; soil blowing hazard; sandstone bedrock at 24 to 40 inch depth.[e]
Fair: susceptible to frost action; low shear strength.	Good	Good	Rapid permeability in substratum; seasonal high water table at depths below 3 feet.	Medium to low permeability of compacted material in subsoil; high permeability of compacted material in substratum.	Moderately well drained.	Moderate available water capacity; moderate water intake rate; seasonal high water table.	Slopes are 0 to 3 percent; sand and gravel in substratum; seasonal high water table.

TABLE 10.—*Interpretations of engineering*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with basements	Trench type sanitary landfill [1]	Local roads and streets
*Burkhardt:						
BrB, BxB — For Sattre part of BxB, see Sattre series.	Slight [2]	Severe: rapid permeability in substratum.	Severe: sidewall instability.	Slight	Severe: rapid permeability in substratum.	Slight
BrC2, BxC2 — For Sattre part of BxC2, see Sattre series.	Moderate: slope. [3]	Severe: rapid permeability in substratum; slope.	Severe: sidewall instability.	Moderate: slope.	Severe: rapid permeability in substratum.	Moderate: slope.
BxD2 — For Sattre part of BxD2, see Sattre series.	Severe: slope [3]	Severe: rapid permeability in substratum; slope.	Severe: sidewall instability; slope.	Severe: slope	Severe: rapid permeability in substratum.	Severe: slope
*Chetek:						
CoC2 — For Onamia part of CoC2, see Onamia series.	Moderate: slope. [3]	Severe: rapid permeability in substratum; slope.	Severe: sidewall instability.	Moderate: slope.	Severe: rapid permeability in substratum.	Moderate: slope.
CoD2 — For Onamia part of CoD2, see Onamia series.	Severe: slope [3]	Severe: rapid permeability in substratum; slope.	Severe: sidewall instability; slope.	Severe: slope	Severe: rapid permeability in substratum.	Severe: slope

properties of the soils—Continued

Suitability as source of—			Soil features affecting—				
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Dikes, levees, and other embankments	Drainage for crops and pasture	Irrigation	Terraces and diversions
Good	Good	Fair: shallow; reclamation of borrow pit difficult.	Rapid permeability in substratum.	High permeability of compacted material; medium to high piping hazard; thin layer.	Somewhat excessively drained.	Low available water capacity; moderate to moderately rapid water intake rate; soil blowing hazard.	Slopes are 1 to 6 percent; shallow to sand and gravel; difficult to vegetate and stabilize; complex slopes; stones.
Good	Good	Fair: shallow; reclamation of borrow pit difficult.	Rapid permeability in substratum.	High permeability of compacted material; medium to high piping hazard; thin layer.	Somewhat excessively drained.	Low available water capacity; moderate to moderately rapid water intake rate; soil blowing hazard; slope.	Slopes are 6 to 12 percent; shallow to sand and gravel; difficult to vegetate and stabilize; complex slopes; stones.
Poor: slope	Good	Poor: slope	Rapid permeability in substratum; slope.	High permeability of compacted material; medium to high piping hazard; thin layer.	Somewhat excessively drained.	Low available water capacity; moderately rapid water intake rate; soil blowing hazard; slope.	Slopes are 12 to 30 percent; shallow to sand and gravel; difficult to vegetate and stabilize; complex slopes; stones.
Good	Good	Fair: shallow; reclamation of borrow pit difficult.	Rapid permeability in substratum.	High permeability of compacted material; medium to high piping hazard; thin layer.	Somewhat excessively drained.	Low available water capacity; moderately rapid water intake rate; soil blowing hazard; slope.	Slopes are 6 to 12 percent; shallow to sand and gravel; difficult to vegetate and stabilize; complex slopes; stones.
Poor: slope	Good	Poor: slope	Rapid permeability in substratum; slope.	High permeability of compacted material; medium to high piping hazard; thin layer.	Somewhat excessively drained.	Low available water capacity; moderately rapid water intake rate; soil blowing hazard; slope.	Slopes are 12 to 20 percent; shallow to sand and gravel; difficult to vegetate and stabilize; complex slopes; stones.

TABLE 10.—*Interpretations of engineering*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with basements	Trench type sanitary landfill[1]	Local roads and streets
Chetek—cont: CoE For Onamia part of CoE, see Onamia series.	Severe: slope[2]	Severe: rapid permeability in substratum; slope.	Severe: sidewall instability; slope.	Severe: slope	Severe: rapid permeability in substratum; slope.	Severe: slope
Clyde: CyA	Severe: high water table; floods.	Severe: high water table; floods.	Severe: high water table; floods.	Severe: high water table; floods.	Severe: clayey; difficult to work; high water table; floods; seasonal high perched water table.	Severe: high water table; floods; low shear strength.
Cromwell Mapped only in complexes with Amery soils.	Moderate where slope is 6 to 12 percent; severe where slope is more than 12 percent.[3]	Severe: rapid permeability in substratum; slope.	Severe: sidewall instability in substratum.	Moderate where slope is 6 to 12 percent; severe where slope is more than 12 percent.	Severe: rapid permeability in substratum.	Moderate where slope is 6 to 12 percent; severe where slope is more than 12 percent.
Cut and fill areas: Cz. Too variable to rate.						
*Dakota: DaA, DaB	Slight[3]	Severe: rapid permeability in substratum.	Severe: sidewall instability of substratum.	Slight	Severe: rapid permeability in substratum; slope.	Slight
DcC2 For Pillot part of DcC2, see Pillot series.	Moderate: slope.[3]	Severe: rapid permeability in substratum; slope.	Severe: sidewall instability of substratum.	Moderate: slope.	Severe: rapid permeability in substratum.	Moderate: slope.
Derinda: DeB	Severe: slow permeability; shale bedrock at 20 to 40 inch depth.	Moderate: slope; shale bedrock at 20 to 40 inch depth; fragmented limestone bedrock at 4 to 6 foot depth.	Severe: clayey; difficult to work; shale bedrock at 20 to 40 inch depth; fragmented limestone bedrock at 4 to 6 foot depth.	Severe: seasonal high perched water table; shale bedrock at 20 to 40 inch depth; fragmented limestone bedrock at 4 to 6 foot depth.	Severe: clayey; difficult to work; shale bedrock at 20 to 40 inch depth; fragmented limestone bedrock at 4 to 6 foot depth; seasonal high perched water table.	Severe: low shear strength; shale bedrock at 20 to 40 inch depth.

properties of the soils—Continued

Suitability as source of—			Soil features affecting—				
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Dikes, levees, and other embankments	Drainage for crops and pasture	Irrigation	Terraces and diversions
Poor: slope	Good	Poor: slope	Rapid permeability in substratum; slope.	High permeability of compacted material; medium to high piping hazard; thin layer.	Somewhat excessively drained.	Low available water capacity; moderately rapid water intake rate; soil blowing hazard; slope.	Slopes are 20 to 30 percent; shallow to sand and gravel; difficult to vegetate and stabilize; complex slopes; stones.
Poor: high water table; low shear strength.	Unsuited	Poor: high water table.	Moderately slow permeability.	Low permeability of compacted material; medium to low shear strength.	Moderately well drained; slow permeability; seasonal high perched water table.	High available water capacity; slow permeability; seasonal high perched water table; slope.	Slopes are 0 to 3 percent; heavy loam substratum; seasonal high perched water table.
Good	Good for sand; fair for gravel; excess fines.	Fair; thin layer.	Rapid permeability in substratum.	High permeability of compacted material in substratum; medium to high piping hazard.	Natural drainage is adequate.	Low available water capacity; moderately rapid water intake rate; slope.	Slopes are 6 to 25 percent; sand and gravel substratum; stones difficult to vegetate and stabilize.
Fair: susceptible to frost action.	Good for sand; poor to unsuited for gravel; excess fines.	Fair: thin layer.	Rapid permeability in substratum.	Medium to low permeability of compacted material in subsoil; high permeability of compacted material in substratum.	Natural drainage is adequate.	Moderate available water capacity; moderate water intake rate; slope.	Slopes are 6 to 12 percent; sand and gravel substratum; stones.
Fair: susceptible to frost action.[4]	Good for sand; poor to unsuited for gravel; excess fines.	Fair: thin layer.	Rapid permeability in substratum.	Medium to low permeability of compacted material in subsoil; high permeability of compacted material in substratum.	Natural drainage is adequate.	Moderate available water capacity; moderate water intake rate; slope.	Slopes are 6 to 12 percent; sand and gravel substratum; stones.
Poor: low shear strength; shale bedrock at 20 to 40 inch depth; fragmented limestone bedrock at 4 to 6 foot depth.	Unsuited	Fair: shallow; reclamation of borrow pit difficult.	Slow permeability; shale bedrock at 20 to 40 inch depth; fragmented limestone bedrock at 4 to 6 foot depth; seasonal high perched water table.	Medium to low permeability of compacted material; medium to low shear strength; shale bedrock at 20 to 40 inch depth.	Moderately well drained; slow permeability; seasonal high perched water table.	Moderate available water capacity; slow permeability.	Slopes are 2 to 6 percent; clay shale bedrock substratum; seasonal high perched water table.

TABLE 10.—*Interpretations of engineering*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with basements	Trench type sanitary landfill [1]	Local roads and streets
Derinda—Cont.: DeC2	Severe: slow permeability; shale bedrock at 20 to 40 inch depth.	Severe: slope; shale bedrock at 20 to 40 inch depth.	Severe: clayey; difficult to work; shale bedrock at 20 to 40 inch depth.	Severe: seasonal high perched water table; shale bedrock at 20 to 40 inch depth.	Severe: clayey; difficult to work; shale bedrock at 20 to 40 inch depth; seasonal high perched water table.	Severe: low shear strength; shale bedrock at 20 to 40 inch depth.
Derinda Variant: DfB	Severe: slow permeability; seasonal high perched water table; shale bedrock at 20 to 40 inch depth.	Severe: seasonal high perched water table; shale bedrock at 20 to 40 inch depth.	Severe: clayey; difficult to work; seasonal high perched water table; shale bedrock at 20 to 40 inch depth.	Severe: high shrink-swell potential; seasonal high perched water table; shale bedrock at 20 to 40 inch depth.	Severe: clayey; difficult to work; seasonal high perched water table; shale bedrock at 20 to 40 inch depth.	Severe: high shrink-swell potential; susceptible to frost action; low shear strength; shale bedrock at 20 to 40 inch depth.
Dickman: DkB	Slight [3]	Severe: rapid permeability in substratum.	Severe: sidewall instability of substratum.	Slight	Severe: rapid permeability in substratum.	Slight
Duelm: Du	Severe: seasonal high water table; floods. [3]	Severe: seasonal high water table; rapid permeability; floods.	Severe: seasonal high water table; sidewall instability; floods.	Severe: seasonal high water table; floods.	Severe: seasonal high water table; rapid permeability; floods.	Moderate: seasonal high water table; floods.
Emmert: EmE	Severe: slope [3]	Severe: very rapid permeability; slope.	Severe: slope; sidewall instability.	Severe: slope	Severe: rapid permeability; sandy.	Severe: slope
Floyd: FdA	Severe: moderately slow permeability; seasonal high perched water table; floods.	Moderate: seasonal perched water table; floods.	Severe: seasonal high perched water table; floods.	Severe: seasonal high perched water table; susceptible to frost action; floods.	Severe: seasonal high perched water table; floods.	Severe: susceptible to frost action; floods.

properties of the soils—Continued

Suitability as source of—			Soil features affecting—				
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Dikes, levees, and other embankments	Drainage for crops and pasture	Irrigation	Terraces and diversions
Poor: low shear strength; shale bedrock at 20 to 40 inch depth; fragmented limestone bedrock at 4 to 6 foot. depth.	Unsuited	Fair: shallow; reclamation of borrow pit difficult; slope.	Slow permeability; shale bedrock at 20 to 40 inch depth; fragmented limestone bedrock at 4 to 6 foot depth; seasonal high perched water table.	Medium to low permeability of compacted material; medium to low shear strength; shale bedrock at 20 to 40 inch depth.	Moderately well drained; slow permeability; seasonal high perched water table.	Moderate available water capacity; slow permeability; seasonal high perched water table; slope.	Slopes are 6 to 12 percent; clay shale bedrock substratum; seasonal high perched water table.
Poor: high shrink-swell potential; susceptible to frost action; seasonal high perched water table; shale bedrock at 20 to 40 inch depth.	Unsuited	Fair; thin layer.	Slow permeability; seasonal high perched water table; shale bedrock at 20 to 40 inch depth.	Low permeability of compacted material; medium to low shear strength; substratum has high shrink-swell potential; shale bedrock at 20 to 40 inch depth.	Somewhat poorly drained; slow permeability.	Moderate available water capacity; slow water intake rate; seasonal high perched water table; slope.	Slopes are 1 to 6 percent; shale bedrock substratum; seasonal high perched water table.
Good	Fair for sand; excess fines; unsuited for gravel.	Good	Rapid permeability in substratum.	Medium to low permeability of compacted material in subsoil; high permeability of compacted material in substratum.	Somewhat excessively drained.	Low available water capacity; moderately rapid water intake rate; slope.	Slopes are 2 to 6 percent; sand substratum; soil blowing hazard.
Fair; seasonal high water table.	Fair for sand; excess fines; seasonal high water table hinders excavation; unsuited for gravel.	Poor: sandy	Rapid permeability; seasonal high water table; floods.	High permeability of compacted material in subsoil; high permeability of compacted material in substratum.	Somewhat poorly drained; floods.	Low available water capacity; rapid water intake rate; seasonal high water table; floods.	Slopes are 2 percent; sandy; seasonal high water table; floods.
Fair to poor; slope.	Good for sand and gravel.	Poor: sandy; slope; thin layer.	Very rapid permeability; slope.	High permeability of compacted material; medium to high piping hazard.	Excessively drained.	Very low available water capacity; rapid water intake rate; slope.	Slopes are 12 to 35 percent; shallow to sand and gravel; difficult to vegetate and stabilize.
Poor: susceptible to frost action.	Unsuited	Good	Moderately slow permeability; seasonal high perched water table; floods.	Medium to low permeability of compacted material; medium shear strength; medium piping hazard.	Somewhat poorly drained; moderately slow permeability; floods.	High available water capacity; slow water intake rate; seasonal high perched water table; floods.	Slopes are 0 to 3 percent; heavy loam substratum; seasonal high perched water table; floods.

TABLE 10.—*Interpretations of engineering*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with basements	Trench type sanitary landfill [1]	Local roads and streets
Fluvaquents: Fe	Severe: occasional flooding; seasonal high water table.	Severe: occasional flooding; seasonal high water table.	Severe: occasional flooding; seasonal high water table.	Severe: occasional flooding; seasonal high water table.	Severe: occasional flooding; seasonal high water table.	Severe: occasional flooding; susceptible to frost action.
Fluvaquents, wet: Fm	Severe: high water table; frequent flooding.	Severe: high water table; frequent flooding.	Severe: high water table; frequent flooding.	Severe: high water table; frequent flooding.	Severe: high water table; frequent flooding.	Severe: high water table; frequent flooding; susceptible to frost action.
Freeon:						
FnB	Severe: seasonal high perched water table.	Moderate: moderate permeability; seasonal high perched water table; slope.	Moderate: seasonal high perched water table.	Moderate: seasonal high perched water table.	Severe: seasonal high perched water table.	Moderate: susceptible to frost action; moderate shrink-swell potential.
FoB	Severe: moderately slow permeability; seasonal high perched water table.	Moderate: slope.	Moderate: seasonal high perched water table.	Moderate: seasonal high perched water table; moderate shrink-swell potential.	Severe: seasonal high perched water table.	Severe: susceptible to frost action; low shear strength.
FoC2	Severe: moderately slow permeability; seasonal high perched water table.	Severe: slope.	Moderate: seasonal high perched water table; slope.	Moderate: seasonal high perched water table; moderate shrink-swell potential; slope.	Severe: seasonal high perched water table.	Severe: susceptible to frost action; low shear strength.
Gotham						
GoB	Slight [2]	Severe: rapid permeability.	Severe: sidewall instability.	Slight	Severe: rapid permeability; sandy.	Slight

properties of the soils—Continued

Suitability as source of—			Soil features affecting—				
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Dikes, levees, and other embankments	Drainage for crops and pasture	Irrigation	Terraces and diversions
Poor: susceptible to frost action; seasonal high water table.	Unsuited	Too variable to rate.	Variable permeability; seasonal high water table; floods.	Medium to low shear strength; medium to high piping hazard.	Somewhat poorly drained; floods; variable permeability.	Moderate to high available water capacity; seasonal high water table; occasional flooding.	Slopes are 0 to 2 percent; seasonal high water table; occasional flooding.
Poor: high water table; susceptible to frost action.	Unsuited	Too variable to rate; high water table.	Variable permeability; high water table; frequent flooding.	Medium to low permeability of compacted material; low shear strength; piping hazard.	Poorly drained and very poorly drained; frequent flooding; variable permeability.	Moderate water intake rate; high water table; floods.	Slopes are 0 to 2 percent; high water table; floods.
Fair: susceptible to frost action; moderate shrink-swell potential.	Unsuited	Good	Moderate permeability; seasonal high perched water table.	Medium to low permeability of compacted material; medium to low shear strength; piping hazard.	Moderately well drained.	High available water capacity; moderate water intake rate; seasonal high perched water table; slope.	Slopes are 2 to 6 percent; seasonal high perched water table; some stones.
Poor: susceptible to frost action; low shear strength.	Unsuited	Good	Moderately slow permeability; seasonal high perched water table.	Low permeability of compacted material; medium to low shear strength.	Moderately well drained.	Very high available water capacity; slow water intake rate; seasonal high perched water table; slope.	Slopes are 2 to 6 percent; clay loam substratum; seasonal high perched water table; some stones.
Poor: susceptible to frost action; low shear strength.	Unsuited	Fair: slope	Moderately slow permeability; seasonal high perched water table.	Low permeability of compacted material; medium to low shear strength.	Moderately well drained.	Very high available water capacity; slow water intake rate; seasonal high perched water table; slope.	Slopes are 2 to 12 percent; clay loam substratum; seasonal high perched water table; some stones.
Good	Fair or poor for sand: fines; unsuited for gravel.[3]	Poor: sandy	Rapid permeability.	Medium permeability of compacted material in subsoil; high permeability of compacted material in substratum; medium to high piping hazard.	Somewhat excessively drained.	Low available water capacity; rapid water intake rate; slope.	Slopes are 2 to 6 percent; sandy; difficult to vegetate and stabilize; soil blowing hazard.

TABLE 10.—*Interpretations of engineering*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with basements	Trench type sanitary landfill [1]	Local roads and streets
Gotham—cont: GoC	Moderate: slope.[3]	Severe: rapid permeability; slope.	Severe: sidewall instability.	Moderate: slope.	Severe: rapid permeability; sandy.	Slight
Gravel pits: Gp. Too variable to rate; severe limitations for most uses.						
Halder: HaA	Severe: seasonal high water table; floods.[5]	Severe: seasonal water table; rapid permeability in substratum; floods.	Severe: seasonal high water table; floods.	Severe: seasonal high water table; floods.	Severe: seasonal high water table; rapid permeability in substratum; floods.	Severe: susceptible to frost action; seasonal high water table; floods.
Hesch: HeB	Slight [6]	Severe: moderately rapid permeability; seepage possible in lower part of substratum.[6]	Severe: sidewall instability of substratum.[6]	Slight [6]	Severe: moderately rapid permeability; seepage possible in lower part of substratum.	Moderate: low shear strength.
HeC2	Moderate: slope.[6]	Severe: moderately rapid permeability; seepage possible in lower part of substratum; slope.[6]	Severe: sidewall instability of substratum.[6]	Moderate: slope.[6]	Severe: moderately rapid permeability; seepage possible in lower part of substratum.	Moderate: low shear strength; slope.
HeD2	Severe: slope [6]	Severe: slope [6]	Severe: slope.[6]	Severe: slope.[6]	Severe: moderately rapid permeability; seepage possible in lower part of substratum.	Severe: slope; low shear strength.
Hubbard: HrB	Slight [3]	Severe: rapid permeability.	Severe: sidewall instability.	Slight	Severe: rapid permeability; sandy.	Slight

properties of the soils—Continued

Suitability as source of—			Soil features affecting—				
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Dikes, levees, and other embankments	Drainage for crops and pasture	Irrigation	Terraces and diversions
Good	Fair or poor for sand: fines; unsuited for gravel.[3]	Poor: sandy	Rapid permeability.	Medium permeability of compacted material in subsoil; high permeability of compacted material in substratum; medium to high piping hazard.	Somewhat excessively drained.	Low available water capacity; rapid water intake rate; slope.	Slopes are 6 to 12 percent; sandy; difficult to vegetate and stabilize; soil blowing hazard.
Fair: seasonal high water table; low shear strength in subsoil; susceptible to frost action.	Good for sand: seasonal high water table hinders excavation; poor for gravel.	Good	Rapid permeability in substratum; seasonal high water table; floods.	Medium to low permeability of compacted material in subsoil; high permeability of compacted material in substratum.	Somewhat poorly drained; floods.	Moderate available water capacity; moderate water intake rate; seasonal high water table; floods.	Slopes are 0 to 3 percent; sand and gravel substratum; seasonal high water table; floods.
Fair: reclamation of borrow area difficult.[6]	Poor for sand: fines; unsuited for gravel.[3, 6]	Good	Moderately rapid and moderate permeability.	Medium to low permeability of compacted material; medium shear strength; medium to high piping hazard.[6]	Well drained	Moderate available water capacity; moderately rapid water intake rate; slope.	Slopes are 2 to 6 percent.
Fair: reclamation of borrow area difficult.[6]	Fair for sand: fines; unsuited for gravel.[3, 6]	Fair: slope	Moderately rapid and moderate permeability.	Medium to low permeability of compacted material; medium shear strength; medium to high piping hazard.[6]	Well drained	Moderate available water capacity; moderately rapid water intake rate; slope.	Slopes are 6 to 12 percent; erosion hazard.[6]
Fair: reclamation of borrow area difficult.[6]	Fair for sand: fines; unsuited for gravel.[3, 6]	Poor: slope	Moderately rapid permeability in subsoil; moderate permeability in substratum; moderately steep.[6]	Medium to low permeability of compacted material; low to high piping hazard.[6]	Well drained	Moderate available water capacity; moderately rapid water intake rate; slope.	Slopes are 12 to 20 percent; erosion hazard.[6]
Good	Good; poorly graded sand; unsuited for gravel.	Poor: sandy	Rapid permeability.	Medium to low permeability of compacted material; medium shear strength in subsoil; high permeability of compacted material in substratum.	Somewhat excessively drained.	Low available water capacity; rapid water intake rate; slope.	Slopes are 0 to 6 percent; sandy; difficult to vegetate and stabilize; soil blowing hazard.

TABLE 10.—*Interpretations of engineering*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with basements	Trench type sanitary landfill[1]	Local roads and streets
Hubbard, loamy substratum:						
HsB	Severe to moderate: moderately slow or moderate permeability in substratum.	Severe: rapid permeability in subsoil.	Severe: sidewall instability.	Slight	Severe: seepage.	Slight
HsC	Severe to moderate: moderately slow or moderate permeability in substratum.	Severe: slope	Severe: sidewall instability.	Moderate: slope.	Severe: seepage.	Moderate: slope.
Huntsville: HuA	Severe: occasional flooding; seasonal high water table in places.	Moderate: seasonal high water table in places; occasional flooding.	Severe: occasional flooding; seasonal high water table in places.	Severe: occasional flooding; seasonal high water table in places.	Severe: occasional flooding; seasonal high water table in places.	Severe: occasional flooding; susceptible to frost action.
Jewett:						
JeA, JeB	Moderate: moderate permeability.	Moderate: moderate permeability.	Slight	Slight	Slight	Moderate: susceptible to frost action.
JeC2	Moderate: moderate permeability; slope.	Severe: slope	Moderate: slope.	Moderate: slope.	Slight	Moderate: susceptible to frost action.
JsA, JsB	Slight[3]	Severe: rapid permeability in substratum.	Moderate: sidewall instability of substratum.	Slight	Severe: rapid permeability in substratum.	Moderate: moderate frost action potential; fines.
Lawler: LcA	Severe: seasonal high water table; floods.[3]	Severe: seasonal high water table; floods; rapid permeability in substratum.	Severe: seasonal high water table; floods.	Severe: seasonal high water table; floods.	Severe: seasonal high water table; floods; rapid permeability in substratum.	Severe: susceptible to frost action; low shear strength; floods.

properties of the soils—Continued

Suitability as source of—			Soil features affecting—				
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Dikes, levees, and other embankments	Drainage for crops and pasture	Irrigation	Terraces and diversions
Fair: low shear strength in substratum.	Poor for sand: fines in substratum; unsuited for gravel.[3]	Poor: sandy	Permeability ranges from rapid in subsoil to moderate or moderately slow in substratum.	Medium to low permeability of compacted material; low to high piping hazard.	Somewhat excessively drained.	Moderate available water capacity; rapid water intake rate; slope.	Slopes are 0 to 6 percent; sandy; difficult to vegetate and stabilize; soil blowing hazard.
Fair: low shear strength in substratum.	Poor for sand: fines in substratum; unsuited for gravel.[3]	Poor: sandy	Permeability ranges from rapid in subsoil to moderate or moderately slow in substratum.	Medium to low permeability of compacted material; low shear strength; high piping hazard.	Somewhat excessively drained.	Moderate available water capacity; rapid water intake rate; slope.	Slopes are 6 to 12 percent; sandy; difficult to vegetate and stabilize; soil blowing hazard.
Poor: susceptible to frost action; low shear strength.	Unsuited	Good	Moderate permeability; occasional flooding; seasonal high water table in places.	Medium to low permeability of compacted material; low shear strength and piping hazard.	Well drained and moderately well drained.	Very high available water capacity; moderate water intake rate; occasional flooding.	Slopes are 0 to 3 percent; seasonal high water tables in places; occasional flooding and situation of channels.
Fair: susceptible to frost action.	Poor: fines[3]	Good	Moderate permeability.	Medium to low permeability of compacted material, shear strength and piping hazard.	Natural drainage is adequate.	High available water capacity; moderate water intake rate; slope.	Slopes are 0 to 6 percent; some stones.
Fair: susceptible to frost action.	Poor: fines[3]	Fair: slope	Moderate permeability.	Medium to low permeability of compacted material; shear strength and piping hazard.	Natural drainage is adequate.	High available water capacity; moderate water intake rate; slope.	Slopes are 6 to 12 percent; some stones.
Fair: moderate frost action potential.[5]	Good	Good	Rapid permeability in substratum.	Medium to low permeability in subsoil; high permeability in substratum.	Natural drainage is adequate.	Moderate available water capacity; moderate water intake rate; slope.	Slopes are 0 to 6 percent; sand and gravel substratum.
Fair: seasonal high water table; low shear strength in subsoil material.	Fair: seasonal high water table hinders excavation.	Good	Rapid permeability in substratum; seasonal high water table; floods.	Medium to low permeability of compacted material in subsoil; high permeability of compacted material in substratum.	Somewhat poorly drained; floods.	Moderate available water capacity; moderate water intake rate; seasonal high water table; floods.	Slopes are 0 to 3 percent; sand and gravel substratum; seasonal high water table; floods.

TABLE 10.—*Interpretations of engineering*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with basements	Trench type sanitary landfill [1]	Local roads and streets
Magnor: MaB	Severe: seasonal high perched water table; floods.	Moderate: slope.	Severe: seasonal high perched water table; floods.	Severe: seasonal high perched water table; floods.	Severe: seasonal high perched water table; floods.	Severe: high frost action potential; floods.
Nickin: NcB	Slight	Severe: Moderate to moderately rapid permeability.	Moderate: sidewall instability of substratum.	Slight	Severe: moderate to moderately rapid permeability. [6]	Moderate: susceptible to frost action.
NcC2	Moderate: slope. [6]	Severe: slope. [6]	Moderate: sidewall instability of substratum. [6]	Moderate: slope.	Severe: moderate to moderately rapid permeability. [6]	Moderate: susceptible to frost action; slope.
NnD2	Severe: slope [6]	Severe: slope. [6]	Severe: slope. [6]	Severe: slope.	Severe: moderate to moderately rapid permeability. [6]	Severe: slope
*Onamia: OmB	Slight [8]	Severe: rapid permeability in substratum.	Moderate: sidewall instability of substratum.	Slight	Severe: rapid permeability in substratum.	Slight
OmC2, OnC2 For Antigo part of OnC2, see Antigo series.	Moderate: slope. [3]	Severe: slope.	Moderate: sidewall instability of substratum; slope.	Moderate: slope.	Severe: rapid permeability in substratum.	Moderate: slope.
OnD2 For Antigo part of OnD2, see Antigo series.	Severe: slope [8]	Severe: slope	Severe: slope	Severe: slope	Severe: rapid permeability in substratum.	Severe: slope

properties of the soils—Continued

Suitability as source of—			Soil features affecting—				
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Dikes, levees, and other embankments	Drainage for crops and pasture	Irrigation	Terraces and diversions
Poor: seasonal high perched water table; susceptible to frost action.	Unsuited	Good	Moderately slow permeability; seasonal high perched water table; floods.	Medium to low permeability of compacted material; medium to low shear strength; medium to low piping hazard.	Seasonal high water table; floods; moderately slow permeability.	High available water capacity; moderate water intake rate; seasonal high perched water table; slope; floods.	Slopes are 1 to 6 percent; seasonal high perched water table; floods; some stones.
Fair: susceptible to frost action; low shear strength.	Fair for sand: fines; unsuited for gravel.[a]	Good	Moderate and moderately rapid permeability.	Medium to low permeability of compacted material; medium shear strength; medium to high piping hazard.	Natural drainage is adequate.	Moderate available water capacity; moderate water intake rate; slope.	Slopes are 2 to 6 percent; sand substratum.
Fair: susceptible to frost action; low shear strength.[c]	Fair for sand: fines; unsuited for gravel.[a]	Fair: slope	Moderate and moderately rapid permeability.	Medium to low permeability of compacted material; medium shear strength; medium to high piping hazard.	Natural drainage is adequate.	Moderate available water capacity; moderate water intake rate; slope.	Slopes are 6 to 12 percent; sand substratum.
Fair: susceptible to frost action; slope; low shear strength.[c]	Fair for sand: fines; unsuited for gravel.[a]	Poor: slope	Moderate and moderately slow permeability.	Medium to low permeability of compacted material; medium shear strength; medium to high piping hazard.	Natural drainage is adequate.	Moderate available water capacity; moderate water intake rate; slope.	Slopes are 12 to 20 percent; sand substratum.
Good	Good	Fair: thin surface layer.	Rapid permeability in substratum.	Medium to low permeability of compacted material in subsoil; high permeability of compacted material in substratum.	Natural drainage is adequate.	Moderate available water capacity; moderate water intake rate; slope.	Slopes are 2 to 6 percent; sand and gravel substratum.
Good	Good	Fair: thin surface layer; slope.	Rapid permeability in substratum.	Medium to low permeability of compacted material in subsoil; high permeability of compacted material in substratum.	Natural drainage is adequate.	Moderate available water capacity; moderate water intake rate; slope.	Slopes are 6 to 12 percent; sand and gravel substratum.
Fair: slope	Good	Poor: slope	Rapid permeability in substratum; slope.	Medium to low permeability of compacted material in subsoil; high permeability of compacted material in substratum.	Natural drainage is adequate.	Moderate available water capacity; moderate water intake rate; slope.	Slopes are 12 to 25 percent; sand and gravel substratum.

TABLE 10.—*Interpretations of engineering*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with basements	Trench type sanitary landfill [1]	Local roads and streets
Orion: OrA	Severe: occasional flooding; seasonal high water table.	Severe: seasonal high water table.	Severe: occasional flooding; seasonal high water table.	Severe: occasional flooding; seasonal high water table.	Severe: occasional flooding; seasonal high water table.	Severe: occasional flooding; susceptible to frost action.
Otterholt: OtB	Moderate: moderate permeability.	Moderate: moderate permeability; slope.	Slight	Slight	Slight	Severe: susceptible to frost action.
OtC	Moderate: moderate permeability; slope.	Severe: slope	Moderate: slope.	Moderate: slope.	Slight	Severe: susceptible to frost action.
OtD2	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Moderate: slope.	Severe: susceptible to frost action.
Pillot: PlA	Slight [3]	Severe: rapid permeability in substratum.	Severe: sidewall instability of substratum.	Slight	Severe: rapid permeability in substratum.	Moderate: susceptible to frost action; low shear strength in upper part of soil. [4]
Plainfield: PmB	Slight [3]	Severe: rapid permeability.	Severe: sidewall instability.	Slight	Severe: rapid permeability; sandy.	Slight
PmC	Moderate: slope. [3]	Severe: rapid permeability; slope.	Severe: sidewall instability.	Moderate: slope.	Severe: rapid permeability; sandy.	Moderate: slope.

properties of the soils—Continued

Suitability as source of—			Soil features affecting—				
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Dikes, levees, and other embankments	Drainage for crops and pasture	Irrigation	Terraces and diversions
Poor: susceptible to frost action.	Unsuited	Good	Moderate permeability; seasonal high water table; occasional flooding.	Medium to low permeability of compacted material; low shear strength; high piping hazard.	Somewhat poorly drained.	Very high available water capacity; occasional flooding; seasonal high water table.	Slopes are 0 to 3 percent; seasonal high water table; occasional flooding and siltation of channels.
Poor: susceptible to frost action.	Unsuited	Good	Moderate permeability.	Medium to low permeability of compacted material; medium to low shear strength; medium to high piping hazard.	Natural drainage is adequate.	Very high available water capacity; moderate water intake rate.	Slopes are 2 to 6 percent; deep silt loam.
Poor: susceptible to frost action.	Unsuited	Fair: slope	Moderate permeability.	Medium to low permeability of compacted material; medium to low shear strength; medium to high piping hazard.	Natural drainage is adequate.	Very high available water capacity; moderate water intake rate; slope.	Slopes are 6 to 12 percent; deep silt loam.
Poor: susceptible to frost action.	Unsuited	Poor: slope	Moderate permeability; slope.	Medium to low permeability of compacted material; medium to low shear strength; medium to high piping hazard.	Natural drainage is adequate.	Very high available water capacity; moderate water intake rate; slope.	Slopes are 12 to 20 percent; deep silt loam.
Fair: susceptible to frost action; low shear strength in upper part of soil.[4]	Good	Good	Rapid permeability in substratum.	Medium to low permeability of compacted material in subsoil; high permeability of compacted material in substratum.	Natural drainage is adequate.	Moderate available water capacity; moderate water intake rate.	Slopes are 0 to 3 percent; sand and gravel substratum at 24 to 40 inch depth.
Good	Good: poorly graded sand; little or no gravel.	Poor: sandy	Rapid permeability.	High permeability of compacted material; medium to high piping hazard.	Natural drainage is excessive.	Low available water capacity; rapid water intake rate.	Slopes are 2 to 6 percent; sandy; difficult to vegetate and stabilize; soil blowing hazard.
Good	Good: poorly graded sand; little or no gravel.	Poor: sandy	Rapid permeability.	High permeability of compacted material; medium to high piping hazard.	Natural drainage is excessive.	Low available water capacity; rapid water intake rate; slope.	Slopes are 6 to 12 percent; sandy; difficult to vegetate and stabilize; soil blowing hazard.

TABLE 10.—*Interpretations of engineering*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with basements	Trench type sanitary landfill [1]	Local roads and streets
Plainfield—Cont.:						
PmD	Severe: slope [3]	Severe: rapid permeability; slope.	Severe: sidewall instability; slope.	Severe: slope	Severe: rapid permeability: sandy.	Severe: slope
Port Byron:						
PoB	Moderate: moderate permeability.	Moderate: moderate permeability; slope.	Slight	Slight	Slight	Severe: susceptible to frost action.
PoC	Moderate: moderate permeability; slope.	Severe: slope	Moderate: slope.	Moderate: slope.	Slight	Severe: susceptible to frost action.
PoD	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Moderate: slope.	Severe: susceptible to frost action.
Renova:						
ReB	Severe: moderately slow permeability.	Moderate: slope.	Slight	Slight	Slight	Moderate: moderate shrink-swell potential; susceptible to frost action.
ReC2	Severe: moderately slow permeability.	Severe: slope	Moderate: slope.	Moderate: slope.	Slight	Moderate: moderate shrink-swell potential; susceptible to frost action.

properties of the soils—Continued

Suitability as source of—			Soil features affecting—				
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Dikes, levees, and other embankments	Drainage for crops and pasture	Irrigation	Terraces and diversions
Fair: slope	Good: poorly graded sand; little or no gravel.	Poor: sandy; slope.	Rapid permeability; slope.	High permeability of compacted material; medium to high piping hazard.	Natural drainage is excessive.	Low available water capacity; rapid water intake rate; slope.	Slopes are 12 to 20 percent; sandy; difficult to vegetate and stabilize; soil blowing hazard.
Poor: susceptible to frost action.	Unsuited	Good	Moderate permeability.	Medium to low permeability of compacted material; medium to low shear strength; medium to high piping hazard.	Natural drainage is adequate.	Very high available water capacity; moderate water intake rate; slope.	Slopes are 2 to 6 percent; deep silt loam.
Poor: susceptible to frost action.	Unsuited	Fair: slope	Moderate permeability.	Medium to low permeability of compacted material; medium to low shear strength; medium to high piping hazard.	Natural drainage is adequate	Very high available water capacity; moderate water intake rate; slope.	Slopes are 6 to 12 percent; deep silt loam.
Poor: susceptible to frost action.	Unsuited	Poor: slope	Moderate permeability; slope.	Medium to low permeability of compacted material; medium to low shear strength; medium to high piping hazard.	Natural drainage is adequate.	Very high available water capacity; moderate water intake rate; slope.	Slopes are 12 to 20 percent; deep silt loam.
Fair: moderate shrink-swell potential; susceptible to frost action.	Unsuited	Good	Moderately slow permeability in substratum.	Low permeability of compacted material; medium to low shear strength; medium to low piping hazard.	Natural drainage is adequate.	High available water capacity; moderate water intake rate; slope.	Slopes are 2 to 6 percent; heavy loam subsoil.
Fair: moderate shrink-swell potential; susceptible to frost action.	Unsuited	Fair: slope	Moderately slow permeability in substratum.	Low permeability of compacted material; medium to low shear strength; medium to low piping hazard.	Natural drainage is adequate.	High available water capacity; moderate water intake rate; slope.	Slopes are 6 to 12 percent; heavy loam subsoil.

TABLE 10.—*Interpretations of engineering*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with basements	Trench type sanitary landfill [1]	Local roads and streets
Renova Variant: RgC2	Moderate: slope.	Severe: slope.	Severe: sidewall instability of substratum.	Moderate: slope.	Severe: Moderate to moderately rapid permeability in substratum.	Moderate: susceptible to frost action; medium shear strength; slope.
RgD2	Severe: slope.	Severe: slope.	Severe: slope; sidewall instability of substratum.	Severe: slope.	Severe: moderate to moderately rapid permeability in substratum.	Severe: slope.
Rib: RhA	Severe: high water table; floods.	Severe: high water table; rapid permeability in substratum; floods.	Severe: high water table; floods.	Severe: high water table; floods.	Severe: high water table; floods.	Severe: high water table; susceptible to frost action; floods.
Ritchey: RnB, RnC2	Severe: limestone bedrock at 10 to 20 inch depth.	Severe: limestone bedrock at 10 to 20 inch depth; slope.	Severe: limestone bedrock at 10 to 20 inch depth.	Severe: limestone bedrock at 10 to 20 inch depth.	Severe: limestone bedrock at 10 to 20 inch depth.	Severe: limestone bedrock at 10 to 20 inch depth.
RnD2, RoE	Severe: limestone bedrock at 10 to 20 inch depth; slope.	Severe: limestone bedrock at 10 to 20 inch depth; slope.	Severe: limestone bedrock at 10 to 20 inch depth; slope.	Severe: limestone bedrock at 10 to 20 inch depth; slope.	Severe: limestone bedrock at 10 to 20 inch depth.	Severe: limestone bedrock at 10 to 20 inch depth; slope.
Rockton: RpB, RpC2	Severe: limestone bedrock at 20 to 40 inch depth.	Severe: limestone bedrock at 20 to 40 inch depth.	Severe: limestone bedrock at 20 to 40 inch depth.	Severe: limestone bedrock at 20 to 40 inch depth.	Severe: limestone bedrock at 20 to 40 inch depth.	Severe: low shear strength.

properties of the soils—Continued

Suitability as source of—			Soil features affecting—				
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Dikes, levees, and other embankments	Drainage for crops and pasture	Irrigation	Terraces and diversions
Fair: susceptible to frost action; medium shear strength.	Fair to poor for sand; fines in some places; unsuited for gravel.	Fair: slope; thin layer.	Moderate to moderately rapid permeability in substratum.	Low permeability of compacted material in subsoil; low to high permeability of compacted material in substratum.	Natural drainage is adequate.	Moderate to high available water capacity; moderate water intake rate; slope.	Slopes are 4 to 12 percent; loamy and sandy substratum.
Fair: susceptible to frost action; medium shear strength; slope.	Fair to poor for sand; fines in some places.	Poor: slope	Moderate to moderately rapid permeability in substratum.	Low permeability of compacted material in subsoil; low to high permeability of compacted material in substratum.	Natural drainage is adequate.	Moderate to high available water capacity; moderate water intake rate; slope.	Slopes are 12 to 20 percent; loamy and sandy substratum.
Poor: high water table; susceptible to frost action.	Good for sand: high water table hinders excavation; poor for gravel; fines.[2]	Poor: high water table.	Rapid permeability in substratum; high water table; floods.	Medium to low permeability of compacted material in subsoil; high permeability of compacted material in substratum.	Poorly drained; moderate permeability; floods.	Moderate available water capacity; moderate water intake rate; high water table; floods.	Slopes are 0 to 3 percent; sand and gravel substratum; high water table; floods.
Poor: limestone bedrock at 10 to 20 inch depth.	Unsuited	Poor: thin layer.	Moderate permeability; limestone bedrock at 10 to 20 inch depth.	Medium to low permeability of compacted material; bedrock at 10 to 20 inch depth; thin layer.	Natural drainage is adequate.	Low available water capacity; moderate water intake rate; shallow rooting depth; slope.	Slopes are 2 to 12 percent; limestone bedrock at 10 to 20 inch depth.
Poor: limestone bedrock at 10 to 20 inch depth; slope.	Unsuited	Poor: thin layer; slope.	Moderate permeability; limestone bedrock at 10 to 20 inch depth; slope.	Medium to low permeability of compacted material; limestone bedrock at 10 to 20 inch depth; thin layer.	Natural drainage is adequate.	Low available water capacity; moderate water intake rate; shallow rooting depth; slope.	Slopes are 12 to 35 percent; limestone bedrock at 10 to 20 inch depth.
Poor: low shear strength; thin layer; limestone bedrock at 20 to 40 inch depth.	Unsuited	Good where slope is 2 to 6 percent; fair where slope is 6 to 12 percent.	Moderate permeability; limestone bedrock at 20 to 40 inch depth.	Medium to low permeability of compacted material; limestone bedrock at 20 to 40 inch depth; thin layer.	Natural drainage is adequate.	Moderate available water capacity; moderate water intake date.	Slopes are 2 to 12 percent; limestone bedrock at 20 to 40 inch depth.

TABLE 10.—*Interpretations of engineering*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with basements	Trench type sanitary landfill[1]	Local roads and streets
Rockton—cont.: RpD2	Severe: limestone bedrock at 20 to 40 inch depth; slope.	Severe: limestone bedrock at 20 to 40 inch depth; slope.	Severe: limestone bedrock at 20 to 40 inch depth; slope.	Severe: limestone bedrock at 20 to 40 inch depth; slope.	Severe: limestone bedrock at 20 to 40 inch depth.	Severe: low shear strength; slope.
*Santiago: SaB	Moderate: moderate permeability.	Moderate: moderate permeability; slope.	Slight	Slight	Slight	Moderate: susceptible to frost action; medium shear strength.
SaC2, ScC2 For Antigo part of ScC2, see Antigo series.	Moderate: moderate permeability; slope.	Severe: slope	Moderate: slope.	Moderate: slope.	Slight	Moderate: susceptible to frost action; medium shear strength.
ScD2 For Antigo part of ScD2, see Antigo series.	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Moderate: slope.	Severe: slope
Saprists and Aquents: Se.	Severe: high water table; floods.	Severe: high water table; floods.	Severe: high water table; floods.	Severe: high water table; floods.	Severe: high water table; floods.	Severe: susceptible to frost action; high water table; floods; low shear strength.
Sattre: ShA, ShB, SlA, SlB	Slight[3]	Severe: rapid permeability in substratum.	Severe: sidewall instability of substratum.	Slight	Severe: rapid permeability in substratum.	Slight
ShC2	Moderate: slope.[3]	Severe: rapid permeability in substratum; slope.	Severe: sidewall instability of substratum; slope.	Moderate: slope.	Severe: rapid permeability in substratum.	Moderate: slope.

properties of the soils—Continued

Suitability as source of—			Soil features affecting—				
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Dikes, levees, and other embankments	Drainage for crops and pasture	Irrigation	Terraces and diversions
Poor: low shear strength; thin layer; limestone bedrock at 20 to 40 inch depth.	Unsuited	Poor: slope	Moderate permeability; limestone bedrock at 20 to 40 inch depth; moderately steep.	Medium to low permeability of compacted material; limestone bedrock at 20 to 40 inch depth; thin layer.	Natural drainage is adequate.	Moderate available water capacity; moderate water intake rate.	Slopes are 12 to 20 percent; limestone bedrock at 20 to 40 inch depth.
Fair: susceptible to frost action.	Unsuited	Good	Moderate permeability.	Medium to low permeability of compacted material; low shear strength; low piping hazard.	Natural drainage is adequate.	High available water capacity; moderate water intake rate; slope.	Slopes are 2 to 6 percent; some stones.
Fair: susceptible to frost action.	Unsuited	Fair: slope	Moderate permeability.	Medium to low permeability of compacted material; low shear strength; low piping hazard.	Natural drainage is adequate.	High available water capacity; moderate water intake rate; slope.	Slopes are 6 to 12 percent; some stones.
Fair: moderate frost action potential.	Unsuited	Poor: slope	Moderate permeability.	Medium to low permeability of compacted material; low shear strength; low piping hazard.	Natural drainage is adequate.	High available water capacity; moderate water intake rate; slope.	Slopes are 12 to 25 percent; some stones.
Poor: high water table; floods; susceptible to frost action; low shear strength.	Unsuited	Poor: high water table.	Variable permeability; high water table; frequent flooding.	Low shear strength; hard to pack; excess humus; frequent flooding.	Very poorly drained; floods; variable permeability; frequent flooding.	Variable characteristics; high water table; frequent flooding.	Slopes are 0 to 2 percent; high water table.
Good	Good for sand; fair for gravel; excess fines.	Good	Rapid permeability in substratum.	Medium to low permeability of compacted material in subsoil; high permeability of compacted material in substratum.	Natural drainage is adequate.	Moderate available water capacity; moderate water intake rate.	Slopes are 0 to 6 percent; sand and gravel substratum.
Good	Good for sand; fair for gravel; excess fines.	Fair: slope	Rapid permeability in substratum.	Medium to low permeability of compacted material in subsoil; high permeability of compacted material in substratum.	Natural drainage is adequate.	Moderate available water capacity; moderate water intake rate; slope.	Slopes are 6 to 12 percent; sand and gravel substratum.

TABLE 10.—*Interpretations of engineering*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with basements	Trench type sanitary landfill[1]	Local roads and streets
Seelyeville: Sm	Severe: high water table; floods.	Severe: high water table; organic soils; floods.	Severe: high water table; organic soils; floods.	Severe: high water table; organic soils; floods.	Severe: high water table; floods; moderately rapid permeability.	Severe: high water table; susceptible to frost action; floods; organic soils.
Skyberg: SrA	Severe: seasonal high perched water table: moderately slow permeability.	Slight	Severe: seasonal high perched water table.	Severe: seasonal high perched water table.	Severe: seasonal high perched water table.	Severe: susceptible to frost action; low shear strength.
Udifluvents: Ud	Severe: occasional flooding; seasonal high water table.	Severe: occasional flooding; seasonal high water table; rapid permeability.	Severe: occasional flooding; seasonal high water table.	Severe: occasional flooding; seasonal high water table.	Severe: occasional flooding; seasonal high water table; sandy.	Severe: occasional flooding.
Vlasaty: VaB	Severe: moderately slow permeability; seasonal high perched water table.	Moderate: slope.	Moderate: seasonal high perched water table.	Moderate: seasonal high perched water table; moderate shrink-swell potential.	Severe: seasonal high perched water table.	Severe: susceptible to frost action.
VaC2	Severe: moderately slow permeability; seasonal high perched water table.	Severe: slope.	Moderate: seasonal high perched water table; slope.	Moderate: seasonal high perched water table; moderate shrink-swell potential.	Severe: seasonal high perched water table.	Severe: susceptible to frost action.
Whalen: WhB	Severe: limestone bedrock at 20 to 40 inch depth.	Severe: limestone bedrock at 20 to 40 inch depth.	Severe: limestone bedrock at 20 to 40 inch depth.	Severe: limestone bedrock at 20 to 40 inch depth.	Severe: limestone bedrock at 20 to 40 inch depth.	Severe: low shear strength.

properties of the soils—Continued

Suitability as source of—			Soil features affecting—				
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Dikes, levees, and other embankments	Drainage for crops and pasture	Irrigation	Terraces and diversions
Poor: high water table; organic soils; susceptible to frost action.	Unsuited	Poor: high water table; oxidizes rapidly.	Moderately rapid permeability; high water table.	Organic soils; compressible; hard to pack; not suited for embankments.	Very poorly drained; frequent flooding; moderately rapid permeability.	Very high available water capacity; rapid water intake rate; high water table; blowing hazard.	Slopes are 0 to 2 percent; unstable organic material; highly erodible high water table.
Poor: susceptible to frost action; low shear strength.	Unsuited	Fair: thin layer.	Moderately slow permeability.	Low permeability of compacted material; low to medium shear strength; low to medium piping hazard.	Somewhat poorly drained; moderately slow permeability.	High available water capacity; moderately slow water intake rate.	Slopes are 0 to 3 percent; firm heavy loam subsoil; seasonal high perched water table.
Fair: seasonal high water table; susceptible to frost action.	Fair: stratified sand; unsuited for gravel.	Poor: sandy	Variable; mostly rapid permeability; seasonal high water table.	High permeability of compacted material; medium to high piping hazard.	Moderately well drained and somewhat poorly drained.	Low available water capacity; rapid water intake rate; seasonal high water table; occasional flooding.	Slopes are 0 to 2 percent; seasonal high water table; sandy; occasional flooding.
Poor: susceptible to frost action; low shear strength.	Unsuited	Fair: thin layer.	Moderately slow permeability; seasonal high perched water table.	Low permeability of compacted material; low to medium shear strength; low to medium piping hazard.	Moderately well drained.	High available water capacity; moderately slow water intake rate; seasonal high perched water table.	Slopes are 2 to 6 percent; very firm; clay loam substratum; seasonal high perched water table.
Poor: susceptible to frost action; low shear strength.	Unsuited	Fair: thin layer; shallow slope.	Moderately slow permeability; seasonal high perched water table.	Low permeability of compacted material; low to medium shear strength and piping hazard.	Moderately well drained.	High available water capacity; moderate water intake rate; seasonal high perched water table; slope.	Slopes are 6 to 12 percent; very firm; clay loam substratum; seasonal high perched water table.
Poor: low shear strength; thin layer; limestone bedrock at 20 to 40 inch depth.	Unsuited	Fair: thin layer.	Moderate permeability; limestone bedrock at 20 to 40 inch depth.	Medium to low permeability of compacted material; limestone bedrock at 20 to 40 inch depth; thin layer.	Natural drainage is adequate.	Moderate available water capacity; moderate water intake rate.	Slopes are 2 to 6 percent; limestone bedrock at 20 to 40 inch depth.

TABLE 10.—*Interpretations of engineering*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with basements	Trench type sanitary landfill[1]	Local roads and streets
Whalen—cont:						
WhC2	Severe: limestone bedrock at 20 to 40 inch depth.	Severe: limestone bedrock at 20 to 40 inch depth.	Severe: limestone bedrock at 20 to 40 inch depth.	Severe: limestone bedrock at 20 to 40 inch depth.	Severe: limestone bedrock at 20 to 40 inch depth.	Severe: low shear strength.
WhD2	Severe: limestone bedrock at 20 to 40 inch depth; slope.	Severe: limestone bedrock at 20 to 40 inch depth; slope.	Severe: limestone bedrock at 20 to 40 inch depth; slope.	Severe: limestone bedrock at 20 to 40 inch depth; slope.	Severe: limestone bedrock at 20 to 40 inch depth.	Severe: low shear strength.

[1] Ratings for trench type sanitary landfill are based on soil investigations to a depth of 5 to 6 feet.
[2] Fines smaller than 0.074 mm (200 sieve).
[3] Some danger of leachate polluting ground water.

all-weather surface expected to carry automobile traffic all year. They have a subgrade of underlying soil material; a base consisting of gravel, crushed rock, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly asphalt or concrete. These roads are graded to shed water and have ordinary provisions for drainage. They are built mainly from soil at hand, and most cuts and fills are less than 6 feet deep.

Soil properties that most affect design and construction of roads and streets are load supporting capacity and stability of the subgrade, and the workability and quantity of cut and fill material available. The AASHTO and Unified classifications of the soil material and the shrink-swell potential indicate traffic supporting capacity. Wetness and flooding affect stability of the material. Slope, depth to hard rock, content of stones and rocks, and wetness affect ease of excavation and amount of cut and fill needed to reach an even grade.

Road fill is soil material used in embankments for roads. The suitability ratings reflect (1) the predicted performance of soil after it has been placed in an embankment that has been properly compacted and provided with adequate drainage and (2) the relative ease of excavating the material at borrow areas.

Sand and gravel are used in great quantities in many kinds of construction. The ratings in table 10 provide guidance about where to look for probable sources. A soil rated as a *good* or *fair* source of sand or gravel generally has a layer at least 3 feet thick, the top of which is within a depth of 5 feet. The ratings do not take into account thickness of overburden, location of the water table, or other factors that affect mining of the materials, and neither do they indicate quality of the deposit.

Topsoil is used for topdressing an area where vegetation is to be established and maintained. Suitability is affected mainly by ease of working and spreading the soil material, as for preparing a seedbed; natural fertility of the material, or the response of plants when fertilizer is applied; and absence of substances toxic to plants. Texture of the soil material and its content of stone fragments also affect suitability. Also considered in the ratings is damage that will result at the site from which topsoil is taken.

Pond reservoir areas hold water behind a dam or embankment. Soils suitable for pond reservoir areas have low seepage, which is related to their permeability and depth to fractured or permeable bedrock or other permeable material.

Dikes, levees, and other embankments require soil material resistant to seepage and piping and of favorable stability, shrink-swell potential, shear strength, and compactibility. Stones or organic material in a soil are among factors that are unfavorable.

Drainage for crops and pasture is affected by the permeability, texture, and structure of the soil; depth to claypan, rock, or other layers that influence rate of water movement; depth to the water table; slope, stability in ditchbanks; susceptibility to flooding; alkalinity and availability of outlets for drainage.

Irrigation of a soil is affected by such features as slope; susceptibility to flooding by streams, water erosion, or soil blowing; soil texture; content of stones; depth of root zone; rate of water intake at the surface; permeability of soil layers below the surface layer that restrict movement of water; amount of water held

properties of the soils—Continued

Suitability as source of—			Soil features affecting—				
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Dikes, levees, and other embankments	Drainage for crops and pasture	Irrigation	Terraces and diversions
Poor: low shear strength; thin layer; limestone bedrock at 20 to 40 inches.	Unsuited [4]	Fair: slope; thin layer.	Moderate permeability; limestone bedrock at 20 to 40 inch depth.	Medium to low permeability of compacted material; limestone bedrock at 20 to 40 inch depth; thin layer.	Natural drainage is adequate.	Moderate available water capacity; moderate water intake rate.	Slopes are 6 to 12 percent; limestone bedrock at 20 to 40 inch depth.
Poor: low shear strength; thin layer; limestone bedrock at 20 to 40 inch depth.	Unsuited [4]	Poor: slope	Moderate permeability; limestone bedrock at 20 to 40 inch depth; moderately steep and steep.	Medium to low permeability of compacted material; limestone bedrock at 20 to 40 inch depth; thin layer.	Natural drainage is adequate.	Moderate available water capacity; moderate water intake rate; moderately steep and steep.	Slopes are 12 to 25 percent; limestone bedrock at 20 to 40 inch depth.

[4] Substratum is good source of road fill.
[5] Permeability of substratum ranges from moderate to moderately slow in some places.
[6] Soft sandstone (weakly cemented) that parts to loose sand when dug with spade; strongly cemented bedrock occurs in a few places at depths ranging from 4 to 6 feet.

available to plants; and need for drainage, or depth to water table or bedrock.

Terraces and diversions are embankments, or ridges, constructed across the slope to intercept runoff so that it soaks into the soil or flows slowly to a prepared outlet. Features that affect suitability of a soil for terraces are uniformity and steepness of slope; depth to bedrock or other unfavorable material; presence of stones; permeability; and resistance to water erosion, soil slipping, and soil blowing. A soil suitable for these structures has outlets for runoff and is not difficult to vegetate.

Test data

Table 11 contains engineering test data for some of the major soil series in St. Croix County. These tests were made to help evaluate the soils for engineering purposes. The engineering classifications given are based on data obtained by mechanical analyses and by tests to determine liquid limits and plastic limits. The mechanical analyses were made by combined sieve and hydrometer methods.

Compaction, or moisture-density, data are important in earthwork. If a soil material is compacted at successively higher moisture content, assuming that the compactive effort remains constant, the density of the compacted material increases until the *optimum moisture* content is reached. After that, density decreases with increase in moisture content. The highest dry density obtained in the compactive test is termed *maximum dry density*. As a rule, maximum strength of earthwork is obtained if the soil is compacted to the maximum dry density.

Tests to determine liquid limit and plastic limit measure the effect of water on the consistence of soil material, as explained for table 9.

Formation and Classification of Soils

The first part of this section tells how the factors of soil formation have affected the development of soils in St. Croix County. In the second part the current system of classifying soils is defined, and the soils of the county are classified according to that system.

The soil series in the county and a profile representative of each series are described in the section "Descriptions of the Soils."

Factors of Soil Formation

Soil is produced by soil-forming processes acting on materials deposited or accumulated by geological agencies. The characteristics of the soil at any given point are determined by the physical and mineralogical composition of the parent material; the climate under which the soil material has accumulated and existed since accumulation; the plant and animal life on and in the soil; the relief, or lay of the land; and the length of time the forces of soil formation have acted on the soil material.

Climate and plant and animal life, chiefly plants, are active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it to a natural body that has genetically related horizons. The effects of climate and

TABLE 11.—*Engineering*

[Tests performed by Wisconsin Department of

Soil name and location	Parent material	Depth	Moisture density [1]		Mechanical analysis [2]	
			Maximum dry density	Optimum moisture	Percentage less than 3 inches passing sieve—	
					1 in	¾ in
		In	*Lb per cu ft*	*Pct*		
Amery loam:						
SW¼SW¼ sec. 23, T. 29 N., R. 15 W. (Modal profile)	Loamy material over sandy loam glacial till.	10–27	127	10	100	98
		30–50	126	10	100	99
Antigo silt loam:						
SW¼SE¼ sec. 25, T. 30 N., R. 19 W. (Lower part of subsoil contains slightly more sand than normal for the series.)	Silty sediment over glacial sand and gravel.	18–25	----------	----------	----------	----------
		34–60	----------	----------	98	96
Burkhardt sandy loam:						
SW¼SW¼ sec. 11, T. 31 N., R. 18 W. (Modal profile)	Sandy loam sediment over glacial sand and gravel.	0–8	----------	----------	----------	----------
		12–16	----------	----------	----------	----------
		20–60	----------	----------	98	96
Clyde silt loam:						
NW¼NW¼ sec. 32, T. 29 N., R. 16 W. (Modal profile)	Silty sediment over heavy loam glacial till.	12–18	----------	----------	----------	----------
		23–28	----------	----------	----------	----------
		34–60	----------	----------	100	99
Derinda silt loam:						
NE¼SE¼ sec. 33, T. 28 N., R. 18 W. (Modal profile)	Silty sediment over silty clay weathered from shale.	15–22	----------	----------	----------	----------
		25–50	93	27	----------	----------
Emmert loamy sand:						
NE¼NE¼ sec. 13, T. 29 N., R. 19 W. (Modal profile)	Glacial sand and gravel ------	8–15	----------	----------	87	81
		15–60	----------	----------	95	90
Freeon silt loam:						
NW¼SW¼ sec. 32, T. 30 N., R. 16 W. (Modal profile)	Silty sediment over sandy loam glacial till.	18–23	----------	----------	99	97
		34–60	130.9	8.0	99	98
Jewett silt loam:						
SE¼SW¼ sec. 19, T. 30 N., R. 17 W. (Modal profile)	Silty sediment over sandy loam glacial till.	19–26	120.0	11.4	94	92
		37–60	126.5	9.5	98	98
Magnor silt loam:						
NW¼NW¼ sec. 32, T. 30 N., R. 16 W. (Modal profile)	Sitly sediment over sandy loam glacial till.	20–25	111.8	11.8	100	99
		30–60	126.8	10.6	99	99
Nickin silt loam:						
SW¼SE¼ sec. 36, T. 30 N., R. 18 W. (Modal profile)	Silty sediment and loamy glacial till over sand weathered from sandstone.	23–30	118.6	13.2	----------	100
		34–60	107.8	12.6	----------	----------
Santiago silt loam:						
SW¼SW¼ sec. 26, T. 28 N., R. 19 W. (Subsoil contains slightly less clay than modal profile.)	Loess over glacial till --------	0–7	109	14	----------	----------
		16–20	122	11	97	96
		23–60	122	11	----------	100
Skyberg silt loam:						
SW¼NE¼ sec. 16, T. 28 N., R. 16 W. (Modal profile)	Silty sediment over heavy loam and clay loam glacial till.	24–36	114	14	----------	----------
		40–60	114	15	----------	----------
SE¼SE¼ sec. 28, T. 29 N., R. 16 W. (Modal profile)		18–25	----------	----------	----------	----------
		32–60	113.0	15.6	----------	----------
Vlasaty silt loam:						
SE¼NW¼ sec. 11, T. 28 N., R. 16 E. (Modal profile)	Loess over clay loam glacial till.	25–30	----------	----------	----------	----------
		35–60	----------	----------	----------	----------
NE¼SE¼ sec. 23, T. 28 N., R. 16 W.		25–30	----------	----------	----------	----------
		30–42	----------	----------	----------	----------

test data

Transportation, Division of Highways]

Mechanical analysis [2]—Continued								Liquid limit [3]	Plasticity index [4]	Classification	
Percentage less than 3 inches passing sieve—Continued					Percentage smaller than—					AASHTO [5]	Unified
⅜ in	No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)	0.05 mm	0.005 mm	0.002 mm				
								Pct			
96	94	91	76	35	29	11	8	19	4	A-2-4(0)	SC-SM
98	96	91	79	39	34	13	9	19	4	A-4(1)	SC-SM
----------	----------	100	92	79	74	27	24	34.8	16.2	A-6(10)	CL
93	89	81	29	2	2	2	2	--------	[6] NP	A-1-b(0)	SP
----------	----------	100	69	32	30	11	7	25.5	NP	A-2-4(0)	SM
----------	100	95	69	32	31	12	8	20.8	3.3	A-2-4(0)	SM
87	78	67	30	1	1	1	1	--------	NP	A-1-b(0)	SP
----------	----------	100	92	80	78	35	29	52.8	26.2	A-7-6(17)	CH
----------	----------	100	94	87	84	32	24	41.5	20.4	A-7-6(12)	CL
96	94	91	81	59	56	29	24	37.4	20.2	A-6(9)	CL
----------	----------	100	97	85	84	55	50	55	32	A-7-6(19)	CH
----------	----------	100	99	97	96	73	63	63	33	A-7-6(20)	CH
68	55	39	19	4	3	1	1	--------	NP	A-1-a(0)	SP
80	66	49	21	4	4	2	1	--------	NP	A-1-a(0)	SP
95	94	92	82	57	53	22	17	27.4	10	A-4-(4)	CL
95	93	91	77	30	27	15	12	17.4	3	A-2-4(0)	SM
90	89	88	76	48	45	23	20	33.4	18.1	A-6(5)	SC
95	94	92	78	34	30	15	12	20.0	6.7	A-2-4(0)	SC-SM
97	93	81	67	38	35	18	15	34.4	18.4	A-6(3)	SC
97	95	92	81	42	38	17	12	18.8	6.6	A-4(1)	SC-SM
98	97	97	87	52	48	20	17	28.2	11.7	A-6(4)	CL
----------	----------	100	99	9	7	3	3	--------	NP	A-3(0)	SP-SM
----------	----------	100	94	74	70	17	9	26	5	A-4(8)	CL-ML
95	93	90	75	39	35	17	13	26	11	A-6(1)	SC
99	97	91	78	41	36	18	15	26	13	A-6(2)	SC
----------	----------	100	93	63	59	42	28	36	19	A-6(9)	CL
----------	----------	100	95	64	60	35	30	36	21	A-6(10)	CL
----------	----------	100	90	64	61	36	31	44.8	27.9	A-7-6(14)	CL
----------	----------	100	93	69	64	36	29	40.3	24.8	A-6(13)	CL
----------	----------	100	93	64	62	35	31	36	19	A-6(9)	CL
----------	----------	100	91	62	60	36	30	40	23	A-6(10)	CL
----------	99	98	90	69	64	----------	33	--------	--------	----------	--------
----------	----------	99	90	69	63	----------	32	--------	--------	----------	--------

TABLE 11.—*Engineering*

Soil name and location	Parent material	Depth	Moisture density [1]		Mechanical analysis [2]	
			Maximum dry density	Optimum moisture	Percentage less than 3 inches passing sieve—	
					1 in	¾ in
		In	*Lb per cu ft*	*Pct*		
Whalen silt loam: NW¼SE¼ sec. 16, T. 28 N., R. 19 W. (Modal profile)	Loess, loamy glacial till, and clayey residium over limestone bedrock.	20–30	----------	----------	86	82
		30–34	----------	----------	---------	---------

[1] Based on AASHTO Designation T99–57, Method A (*1*).

[2] Mechanical analysis according to the AASHTO Designation T88–57 (*1*). Results by this procedure may differ somewhat from the results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHTO procedure, the fine material is analyzed by hydrometer method, and the various grain-size fractions are calculated on the basis of all material up to and including that of 3 inches in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method, and the material coarser than 2 millimeters in diameter is excluded from the calculation of grain-size fraction. The mechanical analysis data used in this table are not suitable for use in naming textural classes of soil.

plant and animal life are conditioned by relief. The parent material also affects the kind of soil profile that is formed and, in extreme cases, determines it almost entirely. Finally, time is needed for changing the parent material into a soil profile. It may be much or little, but some time is always required for differentiation of soil horizons. Usually, a long time is required for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four.

It is now thought that a combination of basic or simple processes proceed in all soils and is responsible for horizon differentiation. All of these processes are at least potential processes in every soil. These processes can be considered under four main headings that generally do not act alone. These headings are *gains, losses, transfers,* and *transformations.* Some of these changes promote horizon differentiation and others retard or offset horizon differentiation. The balance among changes determines the nature of the soil at any given spot.

The results of these soil-forming processes can be briefly summarized using Santiago soils as an illustration. The parent materials of these soils were sandy loam till and windblown silt loam. The silt loam was deposited over the till, probably during and after the glacial period. The high position on the landscape and the porous nature of the underlying till contributed to the characteristics that make these soils well drained. The temperature, climate, and rainfall that was adequate for the growth of plants, were conducive to dissolving minerals and moving them in solution downward in the soil profile. In time, moisture and organic acids started the soil-forming processes. Plants and animals contributed to the accumulation of a leaf litter, organic matter, and organic acids, and they mixed the soil to some extent to form a thin surface layer. These processes were accelerated as more litter accumulated and produced a greater volume of organic residue and acids. Basic minerals and iron in the soil material were gradually dissolved and moved downward by percolating waters. As water continued to move downward through the soil, suspended particles of clay along with iron and other dissolved minerals also were translocated from the upper part of the soil and deposited in the middle part. Thus, the middle part of subsoil contains more clay and iron than upper and lower parts of the Santiago soils.

As a result of these soil-forming processes, the Santiago soils now have a thin, dark colored silt loam surface layer; a thick, leached, light colored subsurface layer; and a subsoil that is mainly reddish brown heavy loam. The substratum is unweathered, sandy loam glacial till that has changed but little since it was deposited by the glacier.

Processes that took place in the formation of Santiago soils were *gains* of organic matter in the surface layer, *loss* of clay from the upper part of the soil and subsequent *transfer* to the lower part of the profile, and *transformation* of iron compounds in the lower subsoil. In varying degrees all these processes are occurring in all soils of the survey area. In St. Croix County, the kinds of parent material and relief, or topography, have, to a great extent, determined the kinds of processes that have been dominant in the formation of all the soils, and they have thus caused differences among the soils. Factors that have contributed to the formation of soils of the survey area are described in more detail in the following paragraphs.

Parent material

Most of the soils of St. Croix County are derived from parent materials that are a direct or indirect result of glaciation. Even the soils that formed in material weathered over bedrock show some glacial influence in

test data—Continued

Mechanical analysis [2]—Continued								Liquid limit [3]	Plasticity index [4]	Classification	
Percentage less than 3 inches passing sieve—Continued					Percentage smaller than—					AASHTO [5]	Unified
⅜ in	No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)	0.05 mm	0.005 mm	0.002 mm				
								Pct.			
80	79	79	72	46	41	18	16	30	14	A-6(3)	SC
		100	89	62	61	38	28	39	21	A-6(10)	CL

[2] Based on AASHTO Designation T89-60 (*1*).
[4] Based on AASHTO Designation T90-56 and AASHTO Designation T91-54 (*1*).
[5] Based on AASHTO Designation M145-49 (*1*).
[6] NP means nonplastic.

the rounded pebbles of mixed origin that they contain. Examples are Whalan and Ritchey soils that occur on dolomitic limestone ridges and side slopes in the southern and western parts of the county. An indirect result of the glacier are Seelyeville soils that formed in decomposed vegetation and have very poor drainage as a result of the damming of earlier drainageways by glacial debris.

Glacial till, windblown silt, and glacial outwash deposits are the most common parent materials in the county. Decomposed vegetation, alluvium, colluvium, and residuum from dolomitic limestone, sandstone, or shale are less common parent materials.

Glacial till is unstratified, unsorted glacial debris composed of clay, silt, sand, gravel, and stones. This material underlies most of the soils in the eastern and northern parts of the county. There are two dominant kinds of till in St. Croix County. The oldest is the Rockian (*10*). It is correlated with the first substage of the Wisconsinan glaciation. The Rockian till has been subjected to longer periods of weathering and erosion than other glacial drifts in the county. Because of later glaciation, most of the Rockian till was either eroded away or buried. However, this till thinly caps a few ridges and a thicker mantle is on the flat uplands. The only extensive areas where this till is near the surface are in the south-central and southeastern parts of the county. The till is yellowish brown loam or clay loam and is less than 5 percent coarse fragments by volume. Igneous stones and cobblestones, mainly basalt, are the most common coarse fragments. Clyde, Renova, Skyberg, and Vlasaty soils are common soils formed in this kind of till in St. Croix County.

The most common till in St. Croix County is the Cary till (*26*). It is correlated with the third substage of the Wisconsinan glaciation. It occurs as terminal moraines and as ground moraines. The terminal moraine, in the northwestern corner of the county, is characterized by steep drift hills and ridges, potholes, and small lakes. The ground moraine immediately to the east and southeast have a more gentle topography. Cary till in St. Croix County is mainly a reddish brown or yellowish red. It is sandy loam or light loam and in some places has lenses or pockets of loose sand and gravel. The volume of coarse fragments ranges from 5 to 30 percent. The fragments are mainly stones, cobblestones, and pebbles that are igneous or metamorphic in origin. Adolph, Amery, Freeon, Magnor, and Santiago soils are common soils developed in this kind of till.

Another important parent material is windblown silt loam or loess which mantles most of the county. The silt loam mantle is 1 to 5 feet thick. It is deepest in areas where the topography is more gentle. It overlies the glacial till, outwash, and bedrock. Where deposited over glacial drift, there is a pebble or cobblestone line separating the windblown silt loam from the drift. Some of the best soils in the county formed entirely in windblown silt loam. Otterholt and Port Byron soils are common soils developed in this material.

Glacial outwash is another important parent material in St. Croix County. This material was deposited by water flowing from the melting glacier. The most valuable deposits are stratified sand and gravel. However, much of the outwash in this county is sandy and contains little or no gravel. Actually, it is difficult to assign a mode of origin to the sandy deposits containing a small amount of gravel. Such sandy deposits generally show little evidence of stratification but contain too much gravel to be considered of windblown or lacustrine origin. The sandy deposits in much of the western part of the county probably have been reworked many times by glacial action. Burkhardt, Chetek, Onamia, Plainfield and Sattre soils formed in glacial outwash.

Organic matter is the parent material for only one soil series in St. Croix County. This type of parent material consists mainly of vegetation such as sedges, reeds, and grasses in advanced stages of decomposition. Seelyeville soils are representative of soils formed in

more than 50 inches of organic material over mineral soil material. The Saprists part of Saprists and Aquents also formed in organic material.

Alluvial and colluvial deposits are also relatively important parent materials in the county. Most of these deposits are of recent origin, and the soils that formed in them do not have distinct horizons. These materials range from silty to sandy in texture and are deposited on stream bottoms and foot slopes by stream floods or local wash of soil materials from higher positions on the landscape. Huntsville and Orion soils and Fluvaquents and Fluvaquents, wet, formed in alluvial and colluvial deposits.

Residuum from weathered bedrock is another parent material in the county. The three kinds of bedrock are dolomitic limestone, sandstone, and shale. Limestone weathers to a clayey residuum that is firm and plastic. This layer is thin or lacking in most places in St. Croix County. Much of residuum was removed by the glacier and since glaciation there has not been sufficient time for further weathering. In most places in the county the soils over limestone formed in windblown silt loam and glacial till and only a thin layer of residuum over the dolomite. Limestone forms the main bedrock underlying most of the county. It is exposed in many of the steep breaks or escarpments in the southwestern part of the county. Isolated outcrops of limestone are also in other parts of the county, mainly along streambanks and along a cuesta that extends along the eastern boundary. In most places the limestone bedrock is covered by glacial till. Ritchey, Rockton, and Whalan soils are underlain by limestone within a depth of 40 inches.

Sandstone weathers to sandy loam, loamy sand, or sand. In St. Croix County most of the sandstone overlies dolomitic limestone, but there also is a sandstone formation under the limestone. The limestone is quite hard and resists weathering, so not much of the underlying sandstone is exposed. The upper sandstone layer consists mainly of medium and fine grained sand grains that are well rounded. Weak cementation makes this sandstone practically worthless as building stone. The sandstone consists, for the most part, of white quartz grains, though occasionally it has bands of iron oxide and kaolinite. The iron creates red or brownish red veins in the sandstone. The kaolinite forms gray and white bands of heavy loam and clay loam and is mainly in the sandstone areas of the southeastern parts of the county. The sandstone strata are so weakly cemented the sandstone often becomes a loose, noncoherent body of sand when dug out with a spade. Geologic erosion has removed most of the exposed sandstone. A few outcrops and some areas in the southwestern quarter and south-central parts of the county remain. Sandstone is also on the upper slopes of a cuesta along the eastern boundary of the county. While the sandstone does not form many outcrops, it has modified soil conditions to a considerable extent. Boone soils formed in sand. This soil has low natural fertility and available water capacity, and the permeability is moderately rapid to very rapid. These properties may range somewhat according to the number and thickness of the bands of iron oxide. Arland, Hesch, and Nickin soils formed partly in residuum from weathered sandstone.

Shale layers occur as a few isolated outcrops in the southwestern parts of St. Croix County. In most places, these layers are only 48 to 60 inches thick and are underlain by fragmented dolomitic limestone. This shale weathers to an olive and olive gray clay which is neutral to moderately alkaline below the solum. Derinda and Derinda Variant soils formed in residuum from weathered shale. They are on the ridgetops of shale uplands and have slow permeability.

Relief and drainage

The hills, valleys, ridges, and plains of St. Croix County are results of the work of rains, rivers, winds, glacial ice, and glacial meltwater over long periods of time. Where bedrock controls the topography, the resistance or lack of resistance of the underlying rocks has determined the relief. Relief, in turn, influences soil formation by controlling drainage, runoff, and other direct or indirect effects of water, including erosion. In many places the relief of a given soil can be correlated closely with the drainage; the thickness and organic matter content of the A1 horizon; the thickness of the solum; and the differentiation of horizons in the soil profile.

In St. Croix County the surface layer is generally light colored on more sloping soils and successively darker and thicker on the more gently sloping soils and in areas where the slope changes from convex to concave. Runoff is slower where the slopes are more gentle, and consequently more water soaks into the soil. As a result, plants grow better on the gentler slopes and more organic matter accumulates in the A1 horizon.

The relationship of relief to soil formation is shown by the general pattern of thin, steep soils and of progressively better developed deeper soils that have gentler slopes. The deeper soils contain more clay in the subsoil than the thin, immature soils. Amery and Santiago soils show the influence of relief on soil development. These soils formed in the same kind of parent material, but the generally more sloping Amery soils lack the clay accumulation and well-defined structure in the B horizon that is characteristic of the deeper, more gently sloping Santiago soils.

Drainage characteristics are generally reflected in the color, degree, and kind of mottling or gleying in the soil profile. Well defined Amery, Antigo, Arland, and Santiago soils are mottle-free throughout the solum. Freeon and Vlasaty soils are moderately well drained and have mottles in the lower part of the B horizon.

Floyd, Magnor, and Skyberg soils are representative of the somewhat poorly drained soils in the county. They are mottled throughout the B and C horizons. Adolph, Auburndale, Clyde, and Rib soils are representative of the poorly drained and very poorly drained soils in the county. They are generally mottled in the A horizon and gleyed in the B and C horizons.

Plant and animal life

Plants and animals in and on the soil provide organic matter and mix the soil material. They bring plant nutrients from the lower to the upper soil horizons.

The influence of different kinds of vegetation on the formation of soils is illustrated by the differences in color between soils that formed under woods and those that formed under prairie grasses. Santiago soils formed under woods and have a lighter colored or

thinner dark colored surface layer and are generally more acid than those formed under grass. Pillot soils formed under grass and have a thick, dark colored surface layer. Soils that formed under grass accumulate more organic matter and retain it longer than soils that formed under trees. The humus contributes to their darker color. Soils that formed in places where the vegetation is a mixture of trees and grasses generally have characteristics of both woodland and prairie soils.

Climate

Climate affects soil formation through the moisture and heat that it contributes to an environment. It has a direct effect on the weathering of rocks and the alteration of parent material through the mechanical action of freezing and thawing and the chemical action generated by the leaching of water. Climate has an indirect effect through its influence on plant and animal life.

Differences in climate within the survey area are too small to have any great effect on differences in the soils. The area is within a climatic zone, however, where both prairie vegetation and woodland vegetation are competing for dominance in the soil-plant regime. Pillot and Port Byron soils are representative of soils that formed under grassland vegetation. They have a thick, dark colored surface layer. Renova, Santiago, and Vlasaty soils formed under woodland vegetation and lack the thick, dark colored surface layer.

Time

Time has had some effect on differences among the soils of the survey area. Soils of the alluvial plains, for example, do not have distinct horizons because the soil material has not been in place long enough for the soil-forming processes to take full effect. Well drained soils that formed in glacial till and in windblown silt loam, on the other hand, have well-defined horizons as the result of processes that have been active for thousands of years. In some soils along natural drainageways, such as Huntsville and Orion soils, new material is added to the surface from time to time and covers an older soil. It has not been in place long enough for distinct horizons to have formed.

Man's activities have been so important that he is often referred to as the sixth soil-forming factor. During the past 125 years, man has influenced the soils to a marked extend by disturbing and altering the natural soil-forming processes. He has greatly altered the original condition of many soils by clearing, burning, and cultivating. He has contributed to accelerated erosion by repeatedly removing plant cover from terraces and uplands. He has often contributed to loss of organic matter through overcultivation and has reduced the infiltration rate. He has changed the loose, porous surface layer to clods through overcultivation and the use of heavy equipment.

Where good management and suitable crop rotations have been used, the soil has not been harmed and crop yields have gradually increased. Additions of animal manure and the growth of grasses such as bromegrass have increased the organic matter content of the surface layer and upper part of the subsoil beyond the level of that in virgin woodland soils.

Man has altered the natural acidity of the soils by liming. The lime has not only improved plant growth but has created a more favorable environment for soil bacteria. The increased bacterial action, in turn, has hastened the decomposition of organic matter that darkens the cultivated part of many soils.

Man has also applied fertilizer to increase the supply of plant nutrients. He has grown alfalfa, which uses its long taproot to transfer calcium and other plant food elements from the lower subsoil and substratum to the surface.

Man has improved drainage by constructing waterways and building water control structures. Drainage of wetlands has permitted cultivation of many high-potential soils but has contributed to a general lowering of the water table throughout the area.

Evidence of other effects of man's activity can be seen in areas where the surface layer is now mostly brown subsoil. This soil loss is also evidenced by the over-thickened surface layer on foot slopes and along natural drainageways, where sediment, washed from the surrounding soils, is 2 to 3 feet or more thick. Included in mapping the Floyd and Orion soils are areas that formed in sediment overlying older, buried soils.

Other changes caused by man's manipulation of the soil and landscape include the tendency towards more flash flooding where woodland cover is removed from the more sloping soils of the watershed; rapid filling of lakes and reservoirs with sediment; contamination of ground water with sewage effluent and fertilizer elements, especially nitrates; and the general effect of pesticides on soil organisms and ground water. All of man's activities affect the soil in some way, but some of the changes will not be evident for many years.

Classification of Soils

Soils are classified so that we can more easily remember their significant characteristics. Classification enables us to assemble knowledge about the soils, to see their relationship to one another and to the whole environment, and to develop principles that help us to understand their behavior and their response to manipulation. First through classification, and then through use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

The narrow categories of classification, such as those used in detailed soil surveys, allow us to organize and apply knowledge about soils in managing farms, fields, and woodlands; in developing rural areas; in engineering work; and in many other ways. Soils are placed in broad classes to facilitate study and comparison in large areas such as countries and continents.

The system of soil classification currently used was adopted by the National Cooperative Soil Survey in 1965. Because this system is under continual study, readers interested in developments of the current system should search the latest literature available (*24, 28*).

The current system of classification has six categories. Beginning with the broadest, these categories are order, suborder, great group, subgroup, family, and series. In this system the criteria used as a basis for

classification are soil properties that are observable and measurable. The properties are chosen, however, so that the soils of similar genesis, or mode of origin, are grouped. The same property or subdivisions of this property may be used in several different categories. In table 12, the soil series of St. Croix County are placed in four categories of the current system. Classes of the current system are briefly defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The properties used to differentiate among soil orders are those that tend to give broad climatic groupings of soils. Three exceptions to this are the Entisols, Histosols, and Vertisols which occur in many different climates. Each order is named with a word of three or four syllables ending in *sol* (Moll-i-sol).

SUBORDER. Each order is subdivided into suborders using those soil characteristics that seem to produce classes with the greatest genetic similarity. The suborders are more narrowly defined than are the orders. The soil properties used to separate suborders are mainly those that reflect either the presence or absence of a water table at a shallow depth, soil climate, the accumulation of clay, iron, or organic carbon in the upper solum, cracking of soils caused by a decrease in soil moisture, and fine stratification. The names of suborders have two syllables. The last syllable indicates the order. An example is *Aquoll* (Aqu, meaning water or wet, and *oll*, from Mollisol).

GREAT GROUP. Soil suborders are separated into great groups on the basis of unformity in the kinds and sequence of soil horizons and features. The horizons used to make separations are those in which clay, carbonates, and other constituents have accumulated or have been removed; and those that have pans that interfere with growth of roots, movement of water, or both. Some features used are soil acidity, soil climate, soil composition, and soil color. The names of great groups have three or four syllables and are made by adding a prefix to the name of the suborder. An example is Haplaquoll (*Hapl*, meaning simple horizons, *aqu* for wetness, or water, and *oll*, from Mollisols).

SUBGROUP. Great groups are subdivided into subgroups, one representing the central (typic) segment of the group, and others called intergrades that have properties of the group and also one or more properties of another great group, suborder, or order. Other subgroups may have soil properties unlike those of any other great group, suborder, or order. The names of subgroups are derived by placing one or more adjectives before the name of the great group. An example is Typic Haplaquolls (a typical Haplaquoll).

FAMILY. Soil families are separated within a subgroup primarily on the basis of properties important to the growth of plants or to the behavior of soils when used for engineering. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, soil depth, and consistence. A family name consists of a series of adjectives preceding the subgroup name. The adjectives are the class names for texture, mineralogy, and so on, that are used as family differentiae (see table 12). An example is the coarse-loamy, mixed, frigid family of Typic Haplaquolls.

Environmental Factors Affecting Soil Use

This section gives information about the main natural and cultural features that affect the use and management of the soils of St. Croix County. It briefly explains those features that affect the existing and potential use of soils for farming and other purposes.

Relief and Drainage

St. Croix County is about 85 percent uplands, 14 percent wetlands, and 1 percent water. Cedar Lake and Bass Lake and the Willow and St. Croix Rivers are all in the western half of the county and make up about 90 percent of the surface water acreage. Generally, drainage is to the southwest toward the Mississippi River. Most of the county is underlain by dolomitic limestone that dips to the south and southwest at a low angle of approximately 9 feet to the mile. The action of erosion on the tilted limestone has produced an east and northeast facing cuesta that extends along the eastern border of the county. It is low and irregular and gradually disappears toward the north, presumably beneath a thick cover of glacial drift. Toward the southern edge of the county, its height is about 200 feet. Traveling west over the cuesta, the land levels out to a large plain consisting mostly of ground moraine and stream terraces. About 65 percent of the soils in the county are nearly level or gently sloping, about 20 percent are sloping, and 15 percent are moderately steep to very steep.

Most of the nearly level and gently sloping soils are on ground moraines and stream terraces throughout the county. A few sloping soils are scattered throughout the county, but most are closely associated with the moderately steep to very steep soils. Generally the moderately steep to very steep soils are located as follows: the cuesta along the eastern and southeastern border of the county; north of River Falls where isolated outliers of limestone bedrock form buttes and narrow ridges; and north and east of Hudson where an end moraine and pitted outwash areas have complex topography consisting of narrow ridges, hills, and depressions.

Geology and Underlying Material

Most of the landscape of St. Croix County consists of glacial drift underlain by dolomitic limestone. The limestone bedrock crops out in a few areas throughout the county, mainly on the buttes and narrow ridges north of River Falls, along streambanks, and along the eastern and southeastern border of the county. There are a number of quarries in these outcrops, for example, the large quarry near Wilson in Springfield Township. These quarries are a source of crushed rock for road construction and crushed agricultural lime.

Dolomitic limestone has natural crevices and fissures which are the result of physical stress and chemical weathering. These crevices present problems in certain areas where the soils are underlain by limestone. For

TABLE 12.—*Classification of the soils*

Series	Family	Subgroup	Order
Adolph[1]	Coarse-loamy, mixed, frigid	Typic Haplaquolls	Mollisols.
Amery	Coarse-loamy, mixed	Typic Glossoboralfs	Alfisols.
Antigo	Fine-silty over sandy or sandy-skeletal, mixed	Typic Glossoboralfs	Alfisols.
Arland	Fine-loamy, mixed	Eutric Glossoboralfs	Alfisols.
Auburndale	Fine-silty, mixed, frigid	Typic Glossaqualfs	Alfisols.
Boone	Mixed, uncoated	Typic Quartzipsamments	Entisols.
Brill	Fine-silty over sandy or sandy-skeletal, mixed	Typic Glossoboralfs	Alfisols.
Burkhardt	Sandy, mixed, mesic	Typic Hapludolls	Mollisols.
Chetek	Coarse-loamy, mixed	Eutric Glossoboralfs	Alfisols.
Clyde	Fine-loamy, mixed, mesic	Typic Haplaquolls	Mollisols.
Cromwell	Sandy, mixed, frigid	Typic Dystrochrepts	Inceptisols.
Dakota	Fine-loamy over sandy or sandy-skeletal, mixed, mesic.	Typic Argiudolls	Mollisols.
Derinda	Fine, mixed, mesic	Typic Hapludalfs	Alfisols.
Derinda Variant	Fine, mixed, mesic	Aquollic Hapludalfs	Alfisols.
Dickman[2]	Sandy, mixed, mesic	Typic Hapludolls	Mollisols.
Duelm	Sandy, mixed	Aquic Haploborolls	Mollisols.
Emmert	Sandy-skeletal, mixed, frigid	Typic Udorthents	Entisols.
Floyd	Fine-loamy, mixed, mesic	Aquic Hapludolls	Mollisols.
Fluvaquents		Typic and Aeric Fluvaquents	Entisols.
Fluvaquents, wet		Typic Fluvaquents	Entisols.
Freeon	Fine-loamy, mixed	Typic Glossoboralfs	Alfisols.
Gotham	Sandy, mixed, mesic	Psammentic Hapludalfs	Alfisols.
Halder	Fine-loamy over sandy or sandy-skeletal, mixed	Aquic Glossoboralfs	Alfisols.
Hesch[3]	Coarse-loamy, mixed, mesic	Typic Argiudolls	Mollisols.
Hubbard	Sandy, mixed	Udorthentic Haploborolls	Mollisols.
Huntsville	Fine-silty, mixed, mesic	Cumulic Hapludolls	Mollisols.
Jewett	Fine-loamy, mixed	Eutric Glossoboralfs	Alfisols.
Lawler	Fine-loamy over sandy or sandy-skeletal, mixed, mesic.	Aquic Hapludolls	Mollisols.
Magnor	Fine-loamy, mixed	Aquic Glossoboralfs	Alfisols.
Nickin	Fine-loamy over sandy or sandy-skeletal, mixed, mesic.	Typic Argiudolls	Mollisols.
Onamia	Fine-loamy over sandy or sandy-skeletal, mixed	Typic Glossoboralfs	Alfisols.
Orion	Coarse-silty, mixed, nonacid, mesic	Aquic Udifluvents	Entisols.
Otterholt	Fine-silty, mixed	Typic Glossoboralfs	Alfisols.
Pillot[4]	Fine-silty over sandy or sandy-skeletal, mixed, mesic.	Typic Argiudolls	Mollisols.
Plainfield	Mixed, mesic	Typic Udipsamments	Entisols.
Port Byron	Fine-silty, mixed, mesic	Typic Hapludolls	Mollisols.
Renova	Fine-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Renova Variant	Fine-loamy over sandy or sandy-skeletal, mixed, mesic.	Typic Hapludalfs	Alfisols.
Rib	Fine-silty over sandy or sandy-skeletal, mixed, nonacid, frigid.	Mollic Haplaquepts	Inceptisols.
Ritchey	Loamy, mixed, mesic	Lithic Hapludalfs	Alfisols.
Rockton	Fine-loamy, mixed, mesic	Typic Argiudolls	Mollisols.
Santiago	Fine-loamy, mixed	Typic Glossoboralfs	Alfisols.
Saprists and Aquents		Saprists and Aquents	Histosols, Entisols.
Sattre[5]	Fine-loamy over sandy or sandy-skeletal, mixed, mesic.	Mollic Hapludalfs	Alfisols.
Seelyeville	Euic	Typic Borosaprists	Histosols.
Skyberg	Fine-loamy, mixed, mesic	Udollic Ochraqualfs	Alfisols.
Udifluvents		Typic and Aquic Udifluvents	Entisols.
Vlasaty	Fine-loamy, mixed, mesic	Glossaquic Hapludalfs	Alfisols.
Whalan	Fine-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.

[1] Taxadjunct to the series. These soils have slightly more clay in the B horizon and upper part of the C horizon than the defined range of the series.

[2] Taxadjunct to the series. These soils are redder in the B horizon and C horizon and contain more silt in the solum and have coarser sand with more gravel in the C horizon than the defined range of the series.

[3] Taxadjunct to the series. The depth of soft sandstone is greater than the defined range of the series.

[4] Taxadjunct to the series. These soils contain less clay than the defined range of the series.

[5] Mapping units ShA, ShB, and ShC2 are taxadjunct to the series. These soils contain less clay in the B horizon than the defined range of the series.

example, there is a danger of ground water pollution from unfiltered septic tank effluent moving down these crevices in soils underlain by limestone at a depth of less than 40 inches. These soils have severe limitations for soil absorption filter fields and for other uses where the ability of the soil to act as a filter is the prime consideration of use. There is also a danger of ground water contamination through sinkholes in the underlying limestone. The rate of water movement through these sinkholes varies from year to year because soil material has settled into them. Also some of these sinks have been filled with stones and refuse. The level of Pine Lake, north of Baldwin, was drastically lowered on several occasions when water drained into a sinkhole. Attempts to plug the hole have not been too successful because the fill material is periodically dislodged and falls deeper into the reaches of the cavern.

The limestone is underlain and overlain by sandstone in St. Croix County. The underlying sandstone is hard. It is exposed in a few areas, mainly along the St. Croix River in the northwest corner of the county and on the lower slopes of the cuesta along the eastern boundary of the county. The overlying sandstone is mainly in the southwestern and south central parts of the county and on the upper slopes near the cuesta along the eastern boundary of the county. This sandstone strata consist mainly of white, well sorted and well rounded quartz grains that are weakly cemented. The sandstone breaks down to loose sand when dug with a spade. That which underlies Cady, Eau Gulle and Springfield Townships contain bands of kaolinite clay in many places. This kaolinite has been used for glazing paper and for the manufacture of fine porcelain.

A few remnants of shale bedrock are in Troy and Kinnickinnic Townships. Soils that formed from shale have a silty clay subsoil that has slow permeability. They have severe limitations for septic tank absorption fields. Water ponds on the soil surface after heavy rains and in spring on these soils.

Most of the southeastern quarter of the county has deposits of heavy loam and clay loam till that has moderately slow permeability. Clyde, Floyd, Renova, Skyberg, and Vlasaty soils are common soils underlain by this till. These soils, especially Clyde, Floyd, and Skyberg soils, have severe limitations for many uses. Most drainageways in this area are wet and are used mainly for wetland pasture. Most of the upland soils are nearly level, gently sloping or sloping. Slopes are long and uniform. The soils are subject to erosion. Practices that control runoff are needed to reduce erosion but can cause wet areas to form on soils with slow or moderately slow permeability.

Most of the northeastern quarter and central part of the county have deposits of sandy loam and light loam till. This till has moderate permeability and contains more coarse fragments than the more clayey till. It is yellowish red and was deposited mostly in ground moraines. Some till in the northwest corner of the county was deposited in an end moraine. This northwest corner is an area of complex topography where glacial till is mixed or closely associated with glacial outwash. Adoph, Amery, Freeon, Magnor, and Santiago are common soils formed in glacial till. Amery, Freeon, and Santiago soils have moderate limitations and Adolph and Magnor soils have severe limitations for most nonfarm uses. The well drained soils underlain by sandy loam or light loam till have long, uniform slopes and are well suited to such erosion control practices as stripcropping, terraces, and diversions.

Glacial outwash is stratified sand and gravel that was deposited by glacial meltwaters. These materials are desirable for roadbuilding and making concrete. Extensive areas of glacial outwash are mainly in the western part of the county. Along the Apple and Willow Rivers and near River Falls are large areas of nearly level and gently sloping soils formed in sandy outwash on stream terraces and outwash plains. These soils are intensively cultivated. They are used to grow corn, peas, soybeans, oats, and alfalfa. Some areas of this outwash plain are pitted and hills and depressions are common. This uneven topography was caused by large blocks of stagnant melting ice that were buried in the outwash deposits. (*26*). Pitted outwash plains generally contain more coarse fragments than the more level outwash of stream terraces and plains. Badly pitted areas are not suited to extensive cultivation because of the hazard of erosion. Also, the soils are thin over sand and gravel and are droughty. Many of these areas are in trees or pasture.

Climate [6]

St. Croix County has a continental climate. Winters are long, cold, and snowy; summers are warm and occasionally humid. Spring and fall are often short. Changes in weather can be expected every few days in winter and spring. The movement of high and low pressure systems from west to east brings a variety of weather throughout the year. The number of days per year when the temperature is 90°F or higher has varied from 34 days in 1936 to none in 1951. The number of days with 0 degrees or lower has varied from 58 days in 1936 to 8 in 1931.

Thunderstorms occur on an average of 40 days a year; extremes for individual years are 58 and 23 days. Hail falls on an average of 2 days a year, and in extreme years on 7 days to none.

Wind, sunshine, and relative humidity records are not available, but data from the Minneapolis climatological station should approximate conditions for St. Croix County.

Northwest winds prevail from November through April, and southeast winds prevail for the remaining months. The windiest month is April, when the average windspeed is 13 miles per hour. The least windy months are July and August, which have an average windspeed of about 9 miles per hour. The wind speed has averaged less than 4 miles per hour about 10 percent of the time, 4 to 12 miles per hour about 55 percent of the time, 13 to 31 miles per hour about 35 percent of the time, and more than 31 miles per hour less than 1 percent of the time.

Sun has shined on an average of between 60 and 70 percent of daylight hours from June through September, about 40 percent for November and December, and between 50 to 60 percent for the remaining months. In winter, relative humidity ranges from an average of 70 percent during the afternoon to 80 percent at night.

[6] By MARVIN W. BURLEY, former state climatologist, National Weather Service, U.S. Department of Commerce.

TABLE 13.—*Probabilities of last freezing temperature in spring and first in fall*

[All data from River Falls, Wisconsin, based on records from 1930 to 1959]

Probability	Dates for given probability and temperature				
	32 ° F or lower	28 ° F or lower	24 ° F or lower	20 ° F or lower	16 ° F or lower
Spring:					
20 percent chance after	May 24	May 15	May 1	April 22	April 6
40 percent chance after	May 17	May 8	April 23	April 14	March 29
60 percent chance after	May 11	May 1	April 17	April 7	March 23
80 percent chance after	May 5	April 24	April 10	March 31	March 15
Fall:					
20 percent chance before	September 16	September 27	October 7	October 19	October 28
40 percent chance before	September 23	October 5	October 14	October 27	November 5
60 percent chance before	September 29	October 11	October 21	November 2	November 11
80 percent chance before	October 5	October 19	October 29	November 10	November 18

TABLE 14.—*Temperature and precipitation data*

[All data from River Falls, Pierce County, Wisconsin, based on records from 1930 to 1959]

	Temperature							Average heating degree days [1]	Precipitation		
	Average			Maximum		Minimum			Average		0.1 inch or more
	Daily maximum	Daily minimum	Monthly	90 ° F and above	32 ° F and below	32 °F and below	0 ° F and below		Total	Snow and sleet	
	°F	°F	°F	*Mean number of days*	*Mean number of days*	*Mean number of days*	*Mean number of days*	*Number*	*Inches*	*Inches*	*Days*
January	23.1	2.8	13.0	0	24	31	14	1,610	0.92	7.6	3
February	27.1	5.7	16.4	0	18	28	11	1,360	0.85	6.6	3
March	37.5	18.6	28.1	0	9	28	3	1,140	1.74	8.5	5
April	55.6	33.6	44.6	([2])	1	14	0	610	2.36	2.0	5
May	68.7	45.9	57.3	([2])	0	3	0	280	3.78	0.2	7
June	77.9	55.9	66.9	3	0	([2])	0	80	4.85	0.0	8
July	83.6	60.3	72.0	6	0	0	0	30	3.88	0.0	6
August	81.2	58.4	69.8	5	0	([2])	0	30	3.39	0.0	6
September	71.7	49.2	60.5	1	0	1	0	190	3.15	([3])	5
October	60.1	38.3	49.2	0	([2])	9	0	490	1.95	0.6	4
November	40.7	23.4	32.1	0	8	24	1	990	1.63	4.9	4
December	28.2	10.2	19.2	0	19	30	8	1,420	1.07	8.0	4
Year	54.6	33.5	44.1	15	79	168	37	8,230	29.57	38.4	60

[1] Base 65° F.
[2] Less than 0.5 day.
[3] Trace, an amount too small to measure.

In summer, the relative humidity averages between 55 percent in the afternoon to a little over 80 percent at night.

Table 13 shows the probability of the last freezing temperatures in spring and the first in fall. Table 14 gives temperature and precipitation data. It also gives the average heating degree days by month (*25*). The degree day is the difference between the average temperature for a given day and 65° F. For example, if the average temperature for a day is 55° F., the degree days counted would be 10. A knowledge of the accumulated degree days for a given period is helpful in calculating the amount of fuel needed to heat a building.

The data in tables 13 and 14 are based on records from 1930 to 1959 at River Falls on the border between Pierce and St. Croix Counties. Although the data are from the extreme southern part of St. Croix County, it should be fairly representative of the county. Temperatures and precipitation vary somewhat from the southern part of the county to the northern part. Such factors as topography, soil types, and calm, clear nights also affect temperatures locally.

The average date of the last freeze in spring is May 14, and the first in the fall is September 26. The grow-

ing season, defined as the number of days between the last freeze in spring and the first in fall, averages 135 days; however, the growing season designation is misleading because different plants have different temperatures at which growth is affected.

Approximately 65 percent of the annual precipitation falls during the 5-month period of May through September. The possibility of 1 inch or more of rain in a 7-day period during the summer is greatest the last three weeks of June, when the chance is 4 years in 10 years. The possibility of a 7-day dry period during the summer is greatest in the last part of July when the chance approaches 2 years in 10 years. About once in 2 years 1.25 inches of rain falls in 1 hour, 1.90 inches falls in 6 hours, and 2.50 inches falls in 24 hours. The greatest amount of precipitation in 24 hours was 4.30 inches on September 1, 1942, and June 24, 1951.

The amount of snowfall in a year has ranged from 80 inches in 1951 to 15 inches in 1931 and 1958. The average date that 1 inch or more of snow falls is November 15. About once in 10 years this snow might fall by October 24 and 9 in 10 years it might fall by December 7.

Water Supply

Most of St. Croix County is in the St. Croix River Basin which includes all or significant parts of eight counties in west-central and northwestern Wisconsin (*31*). St. Croix County is in the southern part of the basin. Ground water moves constantly from areas of discharge. This movement generally conforms to the direction of surface runoff, which is southwesterly toward the Mississippi River. In St. Croix County, ground water runoff is greatest along the Kinnickinnic River where, in August of 1967, it ranged from 0.40 to 0.59 cubic feet per second.

The chief sources of ground water in St. Croix County are sand and gravel deposits, the Prairie du Chien dolomite formation, and the upper part of the Cambrian age sandstone formation. The most extensive areas of sand and gravel are in the western half of the county, mainly along the Apple, St. Croix, and Willow Rivers. These are highly permeable surficial deposits that generally yield large quantities of water. For example, east of the city of Hudson, these deposits fill a deep preglacial valley and have high-capacity wells yielding from 10 to 70 gallons per minute per foot of drawdown. The best potential is in areas where saturated deposits are more than 50 feet thick.

Generally the water quality is good, but the water is easily polluted and the iron content is somewhat high. Depth of wells in this area ranges from 40 to 170 feet. The present rate of use is insignificant in relation to potential yield. Isolated deposits of buried sand and gravel occur in the glacial till throughout the county. They are often less than five feet thick and are at depths ranging from 20 to 365 feet. Most yields range from 5 to 15 gallons per minute and are adequate for domestic use. Generally the water is of good quality. It is not easily polluted, but the iron content is somewhat high.

Presently only four high-capacity wells are known to occur solely in the Prairie du Chien dolomite. Most high-capacity wells in St. Croix County are partly in Prairie du Chien dolomite and partly in the upper part of Cambrian age sandstone. They are very productive, yielding as much as 1,100 gallons per minute. Water quality is good, but the water is very hard and is subject to pollution in some areas. Depth of these wells ranges from 245 to 734 feet.

Natural Vegetation

Forests originally covered nearly 58 percent of the land area in St. Croix County. Large areas of prairie and oak savanna were in the central and western parts of the county, but the eastern third was well-timbered (*7*). The forests in the well-timbered areas consisted mainly of maple and basswood and other hardwood mixtures. Extensive logging operations began in 1840, and lumbering was a major industry until the end of the century. Today only about 11 percent of the land area of the county is in woodland, although the better woodlots consisting mainly of northern hardwoods are in the eastern part of the county. Wooded areas are mostly on soils that are steep, stony, sandy, or wet and that are not suited to cultivated crops.

Transportation and Schools

St. Croix County is served by the Chicago and Northwestern and the Soo Line Railroads. Both of these railroads provide daily freight service. One branch of the Chicago and Northwestern Railroad is an east-west line in the southern half of the county and passes through the communities of Hudson, Roberts, Hammond, Baldwin, Woodville, and Wilson. The other branch of the Chicago and Northwestern Railroad is in a northeasterly direction through the communities of Hudson, New Richmond, and Deer Park. The Soo Line is an east-west line in the northern half of the county and passes through the communities of Somerset and New Richmond, and near Glenwood City.

The county is also serviced by a four-lane interstate highway, two U.S. numbered highways and six State numbered highways. The lettered county highways are entirely hard-surfaced and are in excellent condition. Most county highways and roads are on section lines.

St. Croix County has no commercial airports but scheduled flights are available at the Minneapolis-St. Paul International Airport which is about 30 miles away.

St. Croix County has seven public high schools, one each in Baldwin, Glenwood City, Hammond, Hudson, New Richmond, River Falls, and Somerset. There are no colleges in St. Croix County, but there are several nearby. The closest is the University of Wisconsin of River Falls, which is just across the county line. Other nearby branches of the University of Wisconsin are in Menominee, about 12 miles from St. Croix County, and in Eau Claire, about 40 miles away. The University of Minnesota-St. Paul is about 30 miles away. A vocational school system is in New Richmond and has branches throughout the county.

Industry

About 25 percent of the residents of St. Croix County are employed in manufacturing. The major industries

are food processing and manufacturing of wood products, furniture, refrigerator equipment, machinery, metal products, and plastics. Most of the industry is in the communities of Baldwin, Hudson, and New Richmond. The industrial base of St. Croix County has grown significantly in the past decade. Future growth is very likely because of the urban spread from the Minneapolis-St. Paul metropolitan area. Construction of Interstate Highway 94 through the county made this increase in growth more rapid.

St. Croix County is primarily an agricultural area. Many businesses that service and sell farm machinery and other farm supplies are distributed throughout the county. Several livestock markets in the area buy and sell cattle, calves, hogs, and feeder pigs.

Trends in Soil Use

As is the case generally throughout the United States, the number of farms is decreasing and the average size per farm is increasing. In 1964, there were 2,121 farms in St. Croix County with an average size of 184.6 acres. In 1969, there were 1,845 farms with an average size of 192.1 acres. An increasing amount of land is being put to nonagricultural uses. In 1964, 83.8 percent of the land area was in farms, compared to 75.5 percent in farms in 1969. This change in land use is especially noticeable in the western part of the county where more land is being used for home sites, industrial sites, and recreational areas.

References

(1) American Association of State Highway [and Transportation] Officials. 1970. Standard specifications for highway materials and methods of sampling and testing. Ed. 10, 2 vol., illus.

(2) American Society for Testing and Materials. 1974. Method for classification of soils for engineering purposes. ASTM Stand. D 2487–69. *In* 1974 Annual Book of ASTM Standards, Part 19, 464 pp., illus.

(3) Barrett, James P. and Peter H. Allen. 1966. Predicting yield of extensively managed white pine stands. Univ. N.H. Agric. Exp. Stn., Tech. Bull. 108.

(4) Beatty, M. T., Brickbauer, E. A., Klingelhoets, A. J., and D. A. Rohweder. 1966. What yields from Wisconsin soils? Univ. Wis. Ext. Serv. Spec. Circ. 65, 19 pp., illus.

(5) Bender, William H. 1962. Soils suitable for septic tank filter fields. U.S. Dep. Agric., Soil Conserv. Serv. Bull. 243, 12 pp., illus.

(6) Curtis, John T. 1971. The vegetation of Wisconsin. Univ. Wis. Press.

(7) Curtis, R. O. and B. W. Post. 1962. Site index curves for even-aged northern hardwoods in the Green Mountains of Vermont. Vt. Agric. Exp. Stn. Bull. 629.

(8) Eyre, F. H. and Paul Zehngroff. 1948. Red pine management in Minnesota. U.S. Dep. Agric., Circ. 778.

(9) Eyre, F. H. and Russell K. Lebarron. 1944. Management of jack pine stands in the Lake States. U.S. Dep. Agric. Tech. Bull. 863.

(10) Foss, J. E. and R. H. Rust. 1968. Soil genesis study of the lithologic discontinuity in glacial drift in western Wisconsin. Soil Sci. Soc. Am. Proc. 32, pp. 393–398.

(11) Foster, R. W. 1959. Relation between site indexes of eastern white pine and red maple.

(12) Gevorkiantz, S. R. 1956. Site index curves for jack pine in the Lake States. Lake States For. Exp. Stn. Tech. Note 463.

(13) Gevorkiantz, S. R. 1957. Site index curves for aspen in the Lake States. Lake States For. Exp. Stn. Tech. Note 464.

(14) Gevorkiantz, S. R. 1956. Site index curves for balsam fir in the Lake States. Lake States For. Exp. Stn. Tech. Note 465.

(15) Gevorkiantz, S. R. 1957. Site index curves for white cedar in the Lake States. Lake States For. Exp. Stn. Tech. Note 472.

(16) Gevorkiantz, S. R. 1957. Site index curves for white pine in the Lake States. Lake States For. Exp. Stn. Tech. Note 483.

(17) Gevorkiantz, S. R. 1957. Site index curves for red pine in the Lake States. Lake States For. Exp. Stn. Tech. Note 484.

(18) Gevorkiantz, S. R. 1957. Site index curves for red oak in the Lake States. Lake States For. Exp. Stn. Tech. Note 485.

(19) Gevorkiantz, S. R. 1957. Site index curves for tamarack in the Lake States. Lake States For. Exp. Stn. Tech. Note 498.

(20) Heinselman, M. L. and Z. A. Zasada. 1955. A review of literature relating to quaking aspen sites. Lake States For. Exp. Stn. and Off. of Iron Range Resour. and Rehabil. Stn., Pap. 32.

(21) Plonski, W. L. 1959. Yield tables for fully stocked tolerant hardwoods in Ontario.

(22) Schnur, G. Luther. 1937. Yield, stand, and volume tables for even-aged upland oak forest. U.S. Dep. Agric. Tech. Bull. 560, 88 pp., illus. [Reprinted 1961.]

(23) Shaw, Samuel P. and C. Gordon Fredine. 1956. Wetlands of the United States. U.S. Dep. Inter., Fish and Wildl. Serv. Circ. 39, 67 pp., illus.

(24) Simonson, Roy W. 1962. Soil classification in the United States. Sci. 137: 1027–1034.

(25) Thom, H. C. S. 1954. The rational relationship between heating degree days and temperature. Mon. Weather Rev. 82, pp. 1–6, illus.

(26) Thwaites, F. T. 1946. Outline of glacial geology. 134 pp., illus.

(27) United States Department of Agriculture. 1951. Soil survey manual. U.S. Dep. Agric. Handb. 18, 503 pp., illus. [Supplements replacing pp. 173–188 issued May 1962]

(28) United States Department of Agriculture. 1960. Soil classification, a comprehensive system, 7th approximation. Soil Conserv. Serv., 265 pp., illus. [Supplements issued March 1967, September 1968, April 1969.]

(29) United States Department of Agriculture. 1961. Land capability classification. U.S. Dep. Agric. Handb. 210, 21 pp.

(30) Wisconsin Department of Natural Resources. 1968. Wisconsin forest resource statistics. West Cent. Surv. Rep.

(31) Young, H. L. and S. M. Hendall. 1973. Water resources of Wisconsin, St. Croix River Basin. U.S. Dep. Inter., Geol. Surv., and Univ. Wis. Geol. and Nat. Hist. Surv. Hydrol. Invest. Atlas HA-451.

Glossary

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single mapping unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coat, clay skin.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse fragments. Mineral or rock particles up to 3 inches (2 millimeters to 7.5 centimeters) in diameter.

Coarse textured (light textured) soil. Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.5 to 25 centimeters) in diameter.

Complex, soil. A mapping unit of two or more kinds of soil occurring in such an intricate pattern that they cannot be shown separately on a soil map at the selected scale of mapping and publication.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping (or contour farming). Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically for long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients, as for example in "hillpeats" and "climatic moors."

Drainage, surface. Runoff, or surface flow of water, from an area.

Drift (geology). Material of any sort deposited by geologic processes in one place after having been removed from another; includes drift materials deposited by glaciers and by streams and lakes associated with them.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Erosion. The wearing away of the land surface by running water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes a bare surface.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fine-textured soils. *Moderately fine textured*: Clay loam, sandy clay loam, silty clay loam; *Fine-textured*: sandy clay, silty clay, and clay. Roughly, soil that contains 35 percent or more of clay.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Forage. Plant material used as feed by domestic animals. Forage can be grazed or cut for hay.

Forest type. A term used to describe stands that are similar in composition and development because of ecological factors. A forest type is temporary if its character has been caused by logging, fire, or other passing influences; it is

permanent if no appreciable change is expected and its character is the result of ecological factors alone.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Glacial drift (geology). Pulverized and other rock material transported by glacial ice and then deposited. Also the assorted and unassorted material deposited by streams flowing from glaciers.

Glacial outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by melt water as it flows from glacial ice.

Glacial till (geology). Unassorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Glaciofluvial deposits (geology). Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur as kames, eskers, deltas, and outwash plains.

Gleization. The reduction, translocation, and segregation of soil compounds, notably of iron, usually in the lower horizons, as a result of waterlogging with poor aeration and drainage; expressed in the soil by mottled colors dominated by gray. The soil-forming processes leading to the development of a gley soil.

Gleyed soil. A soil having one or more neutral gray horizons as a result of waterlogging and lack of oxygen. The term "gleyed" also designates gray horizons and horizons having yellow and gray mottles as a result of intermittent waterlogging.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Green manure (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground moraine (geology). Glacial till accumulated beneath the advancing ice and deposited from it during its dissolution, rather than aggregated in a thickened belt at the ice edge; the deposit is relatively thin and characteristically forms an undulating plain with gently sloping swells, sags, and closed depressions.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table, which is the upper limit of saturation.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. The major horizons of mineral soil are as follows:

O horizon.—An organic layer, fresh and decaying plant residue, at the surface of a mineral soil.

A horizon.—The mineral horizon, formed or forming at or near the surface, in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon most of which was originally part of a B horizon.

A2 horizon.—A mineral horizon, mainly a residual concentration of sand and silt high in content of resistant minerals as a result of the loss of silicate clay, iron, aluminum, or a combination of these.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or a combination of these; (2) by prismatic or blocky structure; (3) by redder or browner colors than those in the A horizon; or (4) by a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that from which the solum is presumed to have formed. If the material is known to differ from that in the solum the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Illuviation. The accumulation of material in a soil horizon through the deposition of suspended material and organic matter removed from horizons above. Since part of the fine clay in the B horizon (or subsoil) of many soils has moved into the B horizon from the A horizon above, the B horizon is called an illuvial horizon.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Internal soil drainage. The downward movement of water through the soil profile. The rate of movement is determined by the texture, structure, and other characteristics of the soil profile and underlying layers, and by height of the water table, either permanent or perched. Relative terms for expressing internal drainage are *none, very slow, medium, rapid,* and *very rapid.*

Kame (geology). An irregular, short ridge or hill of stratified glacial drift.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Leaching. The removal of soluble material from soil or other material by percolating water.

Legume. A member of the legume or pulse family (Leguminosae). One of the most important and widely distributed plant families. Includes many valuable forage species, such as peas, beans, peanuts, clover, alfalfa, sweet clover, lespedeza vetch, and kudzu. Practically all legumes are nitrogen-fixing plants, and many of the herbaceous species are used as cover and green-manure crops. Even some of the legumes that have no forage value (crotalaria and some lupines) are used for soil improvement. Other legumes are locust, honeylocust, redbud, mimosa, wisteria, and many tropical plants.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Miscellaneous areas. Areas that have little or no natural soil, are too nearly inaccessible for orderly examination, or cannot otherwise be feasibly classified.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Types are terminal, lateral, medial, and ground.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—few, common, and many; size—fine, medium, and coarse; and contrast—faint, distinct, and prominent. The size measurements are of the diameter along the greatest dimension. Fine indicates less than 5 millimeters (about 0.2 inch); medium, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and coarse, more than 15 millimeters (about 0.6 inch).

Muck. Dark colored, finely divided, well decomposed organic soil material mixed with mineral soil material. The content of organic matter is more than 20 percent.

Munsell notation. A designation of color by degrees of the three single variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Nutrient, plant. Any element taken in by a plant, essential to its growth, and used by it in the production of food and

tissue. Plant nutrients are nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, zinc, and perhaps other elements obtained from the soil; and carbon, hydrogen, and oxygen obtained largely from the air and water.

Organic matter. A general term for plant and animal material, in or on the soil, in all stages of decomposition. Readily decomposed organic matter is often distinguished from the more stable forms that are past the stage of rapid decomposition. Terms used to define organic matter content in percent are as follows:

Class	*Percent organic matter*
Very low	less than 0.5 percent
Low	0.5 to 1 percent
Moderately low	1 to 2 percent
Medium	2 to 4 percent
High	4 to 8 percent
Very high	greater than 8 percent

Organic soil. A general term applied to a soil or to a soil horizon that consists primarily of organic matter, such as peat soils, muck soils, and peaty soil layers.

Parent material. The great variety of unconsolidated organic and mineral material in which soil forms. Consolidated bedrock is not yet parent material by this concept.

Peat. Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Percolation. The downward movement of water through the soil.

Permanent pasture. Pasture that is on the soil for a long time, in contrast to rotation pasture, which is on the soil only a year or two because it is grown in rotation with other crops.

Permeability. The quality that enables the soil to transmit water or air, measured as the number of inches per hour that water moves through the soil. Terms describing permeability are very slow (less than 0.06 inch), slow (0.06 to 0.20 inch), moderately slow (0.2 to 0.6 inch), moderate (0.6 to 2.0 inches), moderately rapid (2.0 to 6.0 inches), rapid (6.0 to 20 inches), and very rapid (more than 20 inches).

pH value. (See Reaction, soil). A numerical designation of acidity and alkalinity in soil.

Podzolization. The process by which a soil is depleted of bases, becomes more acid, and develops a leached surface layer.

Poorly graded. Refers to soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Pore space. That fraction of the total space in a soil that is not occupied by solid particles.

Porosity, soil. The degree to which the soil mass is permeated with pores or cavities.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

pH		*pH*	
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulates over disintegrating rock.

Riprap. Stone, brush and stone, or mattresses of brush and poles placed on earth surfaces, such as the faces of dams or the banks of streams, for protection against water erosion.

Root zone. The part of the soil that can be penetrated by plant roots.

Rotation grazing. Grazing two or more pastures, or parts of a range, in regular order, with definite recovery periods between grazing periods. Contrasts with continuous grazing.

Runoff. The precipitation discharged in stream channels from a drainage area. The water that flows off the land surface without sinking in is called surface runoff; that which enters the ground before reaching surface streams is called groundwater runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandy soils. A broad term for soils of the sand and loamy sand classes; soil material with more than 70 percent sand and less than 15 percent clay.

Second growth (forestry). Forest that originates naturally after removal of a previous stand by cutting, fire, or other cause. A loosely used term for young stands.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage. The rapid movement of water through the soil. Seepage adversely affects the specified use.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Soil. A natural, three-dimensional body at the earth's surface that is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows: very coarse sand (2.0 millimeters to 1.0 millimeter); coarse sand (1.0 to 0.5 millimeter); medium sand (0.5 to 0.25 millimeter); fine sand (0.25 to 0.10 millimeter); very fine sand (0.10 to 0.05 millimeter); silt (0.005 to 0.002 millimeter); and clay (less than 0.002 millimeter).

Soil variant. A soil having properties sufficiently different from those other known soils to suggest establishing a new soil series, but a soil of such limited known area that creation of a new series is not believed to be justified.

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in mature soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristics of the soil are largely confined to the solum.

Stone line. A concentration of coarse fragments in soils that generally marks an old weathering surface. In a cross section, the line may be one fragment or more thick. The line generally overlies material that weathered in place and marks the top of a paleosol. It is ordinarily overlain by recent sediment of variable thickness.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stratified. Arranged in strata, or layers. The term refers to geologic material. Layers in soils that result from the processes of soil formation are called horizons; those inherited from the parent material are called strata.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates that are separated from adjoining aggregates. The principal forms of soil structure are—platy (laminated), prismatic (vertical axis of aggregates longer than horizontal), columnar (prisms with rounded tops), blocky (angular or subangular), and granular. Structureless soils are either single grained (each grain by itself, as in dune sand) or massive (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Technically, the A2 horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

Succession (ecology). The progressive development of vegetation toward its highest ecological expression, or the climax vegetation; replacement of one plant community by another.

Surface layer. A term used in nontechnical soil descriptions for one or more layers above the subsoil. Includes A horizon; has no depth limit.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it can soak into the soil or flow slowly to a prepared outlet without harm. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are sand, loamy sand, sandy loam, loam, silt, silt loam, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Tilth, soil. The condition of the soil, especially the soil structure, as related to the growth of plants. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Topsoil (engineering). Presumably a fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Water table. The upper limit of the soil or underlying rock material that is wholly saturated with water.

Water table, apparent. A thick zone of free water in the soil. An apparent water table is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil.

Water table, artesian. A water table under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole.

Water table, perched. A water table standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to a soil or soil material consisting of particles well distributed over a wide range in size or diameter. Such a soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

GUIDE TO MAPPING UNITS

[For a full description of a mapping unit, read both the description of the mapping unit and the description of the soil series to which the mapping unit belongs. In referring to a capability unit, a woodland suitability group, or any other group, read the introduction to the section for general information about its management]

Map symbol	Mapping unit	Described on page	Capability unit	Woodland group	Wildlife group	Recreation group	Tree and shrub group
			Symbol	Symbol	Number	Number	Number
AdA	Adolph silt loam, 0 to 3 percent slopes	10	IVw-3	5w1	7	6	3
A1B	Amery sandy loam, 2 to 6 percent slopes	11	IIIe-4	2o1	1	1	1
A1C2	Amery sandy loam, 6 to 12 percent slopes, eroded	11	IIIe-7	2o1	1	1	1
A1D2	Amery sandy loam, 12 to 25 percent slopes, eroded	11	VIe-4	2r1	1	1	1
AmB	Amery loam, 2 to 6 percent slopes	11	IIe-1	2o1	1	1	1
AmC2	Amery loam, 6 to 12 percent slopes, eroded	11	IIIe-1	2o1	1	1	1
AmD2	Amery loam, 12 to 20 percent slopes, eroded	12	IVe-2	2r1	1	1	1
AmE2	Amery loam, 20 to 30 percent slopes, eroded	12	VIe-1	2r1	1	1	1
AnC2	Amery-Cromwell sandy loams, 6 to 12 percent slopes, eroded	12	IVe-4	2o1	1	1	1
AnD2	Amery-Cromwell sandy loams, 12 to 25 percent slopes, eroded	12	VIe-4	2r1	1	1	1
AoA	Antigo silt loam, 0 to 2 percent slopes	14	IIs-1	2o1	1	1	1
AoB	Antigo silt loam, 2 to 6 percent slopes	14	IIe-2	2o1	1	1	1
ApC2	Arland sandy loam, 6 to 12 percent slopes, eroded	15	IIIe-7	2o1	1	1	1
ApD2	Arland sandy loam, 12 to 25 percent slopes, eroded	15	IVe-7	2r1	1	1	1
ApF	Arland sandy loam, 25 to 35 percent slopes	15	VIIe-2	2r1	1	1	1
AsB	Arland silt loam, 2 to 6 percent slopes	15	IIe-2	2o1	1	1	1
AsC2	Arland silt loam, 6 to 12 percent slopes, eroded	15	IIIe-2	2o1	1	1	1
AuA	Auburndale silt loam, 0 to 3 percent slopes	16	IIIw-3	3w2	7	6	3
BnB	Boone loamy fine sand, 2 to 6 percent slopes	17	IVs-3	3s1	3	2	2
BnC	Boone loamy fine sand, 6 to 12 percent slopes	17	VIs-3	3s1	3	2	2
BnD	Boone loamy fine sand, 12 to 20 percent slopes	17	VIIs-3	3s3	3	2	2
BpA	Brill silt loam, 0 to 3 percent slopes	18	IIs-1	2o1	1	5	1
BrB	Burkhardt sandy loam, 1 to 6 percent slopes	19	IIIe-3	3d1	4	1	2
BrC2	Burkhardt sandy loam, 6 to 12 percent slopes, eroded	19	IVe-3	3d1	4	1	2
BxB	Burkhardt-Sattre complex, 2 to 6 percent slopes	19	IIIe-3	3d1	4	1	2
BxC2	Burkhardt-Sattre complex, 6 to 12 percent slopes, eroded	19	IVe-3	3d1	4	1	2
BxD2	Burkhardt-Sattre complex, 12 to 30 percent slopes, eroded	20	VIe-3	3d2	4	1	2

Map symbol	Mapping unit	Described on page	Capability unit	Woodland group	Wildlife group	Recreation group	Tree and shrub group
			Symbol	Symbol	Number	Number	Number
CoC2	Chetek-Onamia complex, 6 to 12 percent slopes, eroded	21	IVe-3	3d1	4	1	2
CoD2	Chetek-Onamia complex, 12 to 20 percent slopes, eroded	21	VIe-3	3d2	4	1	2
CoE	Chetek-Onamia complex, 20 to 30 percent slopes	21	VIIe-3	3d2	4	1	2
CyA	Clyde silt loam, 0 to 3 percent slopes	23	IIw-1	4w2	7	6	3
Cz	Cut and fill areas	23	------	---	---	1	---
DaA	Dakota loam, 0 to 2 percent slopes	24	IIs-1	---	5	1	1
DaB	Dakota loam, 2 to 6 percent slopes	24	IIe-2	---	5	1	1
DcC2	Dakota-Pillot complex, 6 to 12 percent slopes, eroded	24	IIIe-2	---	5	1	1
DeB	Derinda silt loam, 2 to 6 percent slopes	25	IIe-6	2o1	2	4	1
DeC2	Derinda silt loam, 6 to 12 percent slopes, eroded	26	IIIe-6	2o1	2	4	1
DfB	Derinda Variant silt loam, 1 to 6 percent slopes	26	IIw-3	3o2	6	5	3
DkB	Dickman sandy loam, 2 to 6 percent slopes	27	IIIe-3	3o1	5	1	2
Du	Duelm loamy sand	28	IVw-5	3s2	6	5	3
EmE	Emmert loamy sand, 12 to 35 percent slopes	28	VIIs-5	4f2	3	2	2
FdA	Floyd silt loam, 0 to 3 percent slopes	29	IIw-2	4o1	6	5	3
Fe	Fluvaquents	29	IIw-13	3o2	6	5	3
Fm	Fluvaquents, wet	29	Vw-14	4w2	7	6	3
FnB	Freeon silt loam, 2 to 6 percent slopes	30	IIe-1	1o1	1	5	1
FoB	Freeon silt loam, heavy substratum, 2 to 6 percent slopes	31	IIe-1	1o1	1	5	1
FoC2	Freeon silt loam, heavy substratum, 6 to 12 percent slopes, eroded	31	IIIe-1	1o1	1	5	1
GoB	Gotham loamy fine sand, 2 to 6 percent slopes	31	IVs-3	3s1	3	2	2
GoC	Gotham loamy fine sand, 6 to 12 percent slopes	32	IVs-3	3s1	3	2	2
Gp	Gravel pits	32	------	---	---	---	---
HaA	Halder silt loam, 0 to 3 percent slopes	33	IIw-5	3o2	6	5	3
HeB	Hesch fine sandy loam, 2 to 6 percent slopes	33	IIIe-4	3o1	5	1	1
HeC2	Hesch fine sandy loam, 6 to 12 percent slopes, eroded	34	IIIe-2	3o1	5	1	1
HeD2	Hesch fine sandy loam, 12 to 20 percent slopes, eroded	34	IVe-2	3r1	5	1	1
HrB	Hubbard loamy sand, 0 to 6 percent slopes	34	IVs-3	3s1	3	2	2
HsB	Hubbard loamy sand, loamy substratum, 0 to 6 percent slopes	34	IIIe-4	3s1	5	2	1
HsC	Hubbard loamy sand, loamy substratum, 6 to 12 percent slopes	35	IVe-4	3s1	5	2	1
HuA	Huntsville silt loam, 0 to 3 percent slopes	35	IIw-11	2o1	9	5	1
JeA	Jewett silt loam, 0 to 2 percent slopes	37	I-4	2o1	1	1	1
JeB	Jewett silt loam, 2 to 6 percent slopes	37	IIe-1	2o1	1	1	1

Map symbol	Mapping unit	Described on page	Capability unit	Woodland group	Wildlife group	Recreation group	Tree and shrub group
			Symbol	Symbol	Number	Number	Number
JeC2	Jewett silt loam, 6 to 12 percent slopes, eroded	37	IIIe-1	2o1	1	1	1
JsA	Jewett silt loam, sandy substratum, 0 to 2 percent slopes	37	IIs-1	2o1	1	1	1
JsB	Jewett silt loam, sandy substratum, 2 to 6 percent slopes	37	IIe-2	2o1	1	1	1
LcA	Lawler silt loam, 0 to 3 percent slopes	38	IIw-5	4o1	6	5	3
MaB	Magnor silt loam, 1 to 6 percent slopes	39	IIw-4	2o2	6	5	3
NcB	Nickin silt loam, 2 to 6 percent slopes	40	IIe-2	---	5	1	1
NcC2	Nickin silt loam, 6 to 12 percent slopes, eroded	40	IIIe-2	---	5	1	1
NnD2	Nickin loam, 12 to 20 percent slopes, eroded	40	IVe-2	---	5	1	1
OmB	Onamia loam, 2 to 6 percent slopes	41	IIe-2	2o1	1	1	1
OmC2	Onamia loam, 6 to 12 percent slopes, eroded	41	IIIe-2	2o1	1	1	1
OnC2	Onamia-Antigo complex, 6 to 12 percent slopes, eroded	41	IIIe-2	2o1	1	1	1
OnD2	Onamia-Antigo complex, 12 to 25 percent slopes, eroded	41	IVe-2	2r1	1	1	1
Ora	Orion silt loam, 0 to 3 percent slopes	42	IIw-13	3o2	6	5	3
OtB	Otterholt silt loam, 2 to 6 percent slopes	43	IIe-1	1o1	1	1	1
OtC	Otterholt silt loam, 6 to 12 percent slopes	43	IIIe-1	1o1	1	1	1
OtD2	Otterholt silt loam, 12 to 20 percent slopes, eroded	44	IVe-1	1r1	1	1	1
PlA	Pillot silt loam, 0 to 3 percent slopes	45	IIs-1	---	5	1	1
PmB	Plainfield loamy sand, 2 to 6 percent slopes	45	IVs-3	3s1	3	2	2
PmC	Plainfield loamy sand, 6 to 12 percent slopes	45	VIs-3	3s1	3	2	2
PmD	Plainfield loamy sand, 12 to 20 percent slopes	46	VIIs-3	3s3	3	2	2
PoB	Port Byron silt loam, 2 to 6 percent slopes	46	IIe-1	---	5	1	1
PoC	Port Byron silt loam, 6 to 12 percent slopes	46	IIIe-1	---	5	1	1
PoD	Port Byron silt loam, 12 to 20 percent slopes	47	IVe-1	---	5	1	1
ReB	Renova silt loam, 2 to 6 percent slopes	47	IIe-1	2o1	1	4	1
ReC2	Renova silt loam, 6 to 12 percent slopes, eroded	48	IIIe-1	2o1	1	4	1
RgC2	Renova Variant loam, 4 to 12 percent slopes, eroded	48	IIIe-2	2o1	1	1	1
RgD2	Renova Variant loam, 12 to 20 percent slopes, eroded	49	IVe-2	2r1	1	1	1
RhA	Rib silt loam, 0 to 3 percent slopes	49	IIw-5	3w2	7	6	3
RnB	Ritchey silt loam, 2 to 6 percent slopes	50	IIIe-3	3d1	4	3	2
RnC2	Ritchey silt loam, 6 to 12 percent slopes, eroded	50	IVe-3	3d1	4	3	2

GUIDE TO MAPPING UNITS--Continued

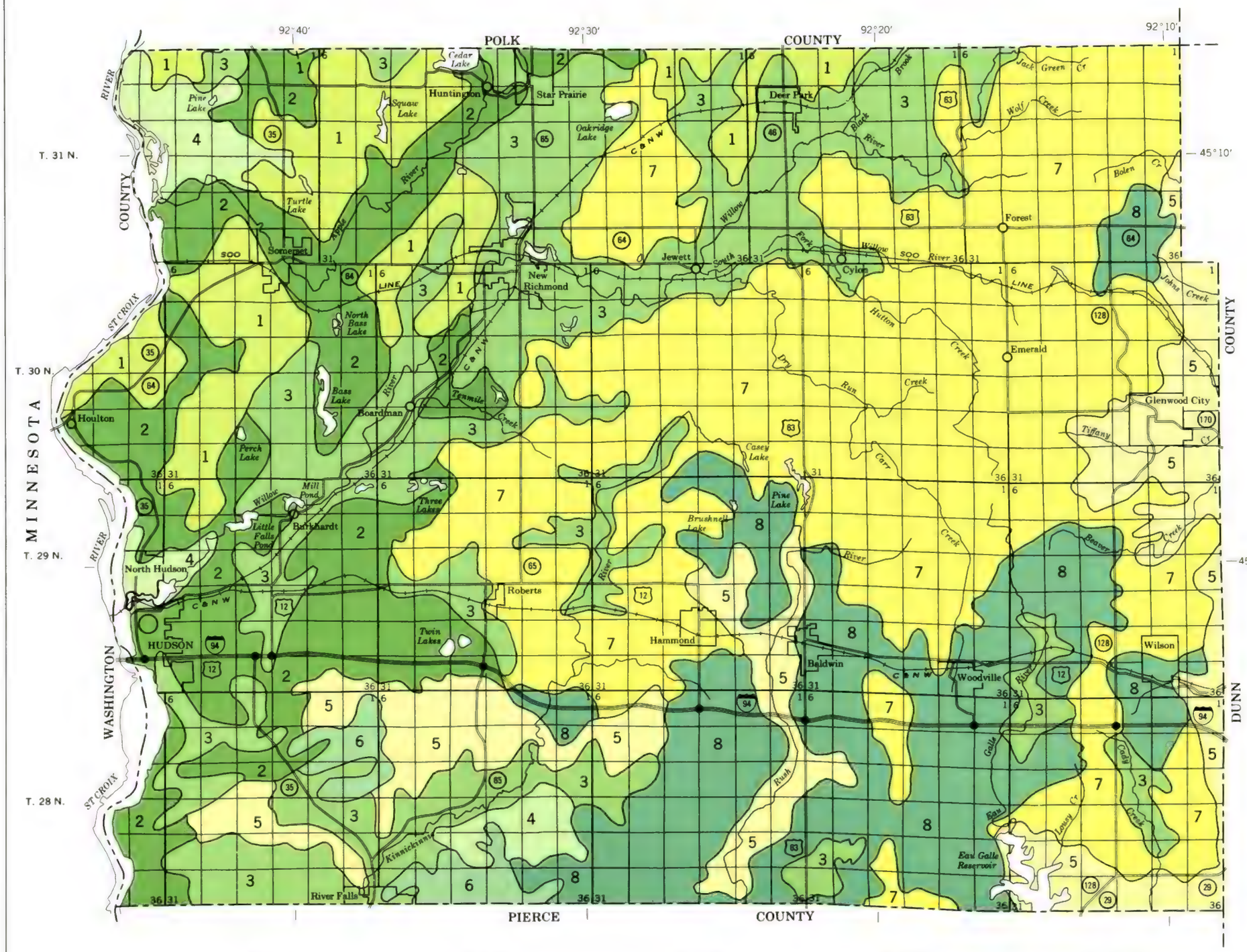
Map symbol	Mapping unit	Described on page	Capability unit	Woodland group	Wildlife group	Recreation group	Tree and shrub group
			Symbol	Symbol	Number	Number	Number
RnD2	Ritchey silt loam, 12 to 20 percent slopes, eroded	50	VIe-3	3d2	4	3	2
RoE	Ritchey soils and Rock outcrop, 20 to 35 percent slopes	51	VIIe-3	3d2	10	3	2
RpB	Rockton silt loam, 2 to 6 percent slopes	52	IIe-2	---	5	3	1
RpC2	Rockton silt loam, 6 to 12 percent slopes, eroded	52	IIIe-2	---	5	3	1
RpD2	Rockton silt loam, 12 to 20 percent slopes, eroded	52	IVe-2	---	5	3	1
SaB	Santiago silt loam, 2 to 6 percent slopes	53	IIe-1	1o1	1	1	1
SaC2	Santiago silt loam, 6 to 12 percent slopes, eroded	53	IIIe-1	1o1	1	1	1
ScC2	Santiago-Antigo complex, 6 to 12 percent slopes, eroded	53	IIIe-1	1o1	1	1	1
ScD2	Santiago-Antigo complex, 12 to 25 percent slopes, eroded	53	IVe-1	1r1	1	1	1
Se	Saprists and Aquents	54	VIIIw-15	6w1	7	6	---
ShA	Sattre loam, 0 to 2 percent slopes	55	IIs-1	2o1	1	1	1
ShB	Sattre loam, 2 to 6 percent slopes	55	IIe-2	2o1	1	1	1
ShC2	Sattre loam, 6 to 12 percent slopes, eroded	55	IIIe-2	2o1	1	1	1
SlA	Sattre silt loam, 0 to 2 percent slopes	56	IIs-1	2o1	1	1	1
SlB	Sattre silt loam, 2 to 6 percent slopes	56	IIe-2	2o1	1	1	1
Sm	Seelyeville muck	56	IVw-9	3w3	8	6	4
SrA	Skyberg silt loam, 0 to 3 percent slopes	57	IIw-2	2o2	6	5	3
Ud	Udifluvents	57	VIIs-9	3s1	6	5	2
VaB	Vlasaty silt loam, 2 to 6 percent slopes	58	IIe-1	2o1	2	4	1
VaC2	Vlasaty silt loam, 6 to 12 percent slopes, eroded	59	IIIe-1	2o1	2	4	1
WhB	Whalan silt loam, 2 to 6 percent slopes	59	IIe-2	2o1	1	3	1
WhC2	Whalan silt loam, 6 to 12 percent slopes, eroded	60	IIIe-2	2o1	1	3	1
WhD2	Whalan silt loam, 12 to 25 percent slopes, eroded	60	IVe-2	2r1	1	3	1

☆U.S. GOVERNMENT PRINTING OFFICE: 1978—230-120/3

NRCS Accessibility Statement

This document is not accessible by screen-reader software. The Natural Resources Conservation Service (NRCS) is committed to making its information accessible to all of its customers and employees. If you are experiencing accessibility issues and need assistance, please contact our Helpdesk by phone at 1-800-457-3642 or by e-mail at ServiceDesk-FTC@ftc.usda.gov. For assistance with publications that include maps, graphs, or similar forms of information, you may also wish to contact our State or local office. You can locate the correct office and phone number at http://offices.sc.egov.usda.gov/locator/app.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.



N

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

RESEARCH DIVISION OF THE COLLEGE OF AGRICULTURAL AND LIFE SCIENCES, UNIVERSITY OF WISCONSIN

GENERAL SOIL MAP

ST CROIX COUNTY, WISCONSIN

Scale 1:190,080

1 0 1 2 3 4 Miles

SOIL ASSOCIATIONS

SOILS WITH MODERATE TO VERY RAPID PERMEABILITY

1 Amery-Cromwell association: Well drained and somewhat excessively drained, gently sloping to steep, medium textured and moderately coarse textured soils on glacial drift plains

2 Burkhardt-Chetek-Sattre association: Well drained and somewhat excessively drained, nearly level to steep, medium textured and moderately coarse textured soils on outwash plains and stream terraces

3 Sattre-Pillot-Antigo association: Well drained, nearly level to sloping, medium textured soils on outwash plains and stream terraces

4 Plainfield-Boone association: Excessively drained, gently sloping to moderately steep, coarse textured soils on outwash plains and stream terraces, and soils underlain by sandstone at a relatively shallow depth; on uplands

SOILS WITH MODERATE TO SLOW PERMEABILITY

5 Santiago-Otterholt-Arland association: Well drained, gently sloping to steep, medium textured soils on till plains, and soils underlain by sandstone at a relatively shallow depth or that have a thick mantle of windblown silt loam

6 Ritchey-Derinda-Whalan association: Well drained and moderately well drained, gently sloping to very steep, medium textured soils underlain by limestone or shale at a relatively shallow depth; on uplands

7 Santiago-Jewett-Magnor association: Well drained and somewhat poorly drained, nearly level to sloping, medium textured soils on till plains

8 Vlasaty-Skyberg association: Moderately well drained and somewhat poorly drained, nearly level to sloping, medium textured soils on till plains

Compiled 1977

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

INDEX TO MAP SHEETS

ST CROIX COUNTY, WISCONSIN

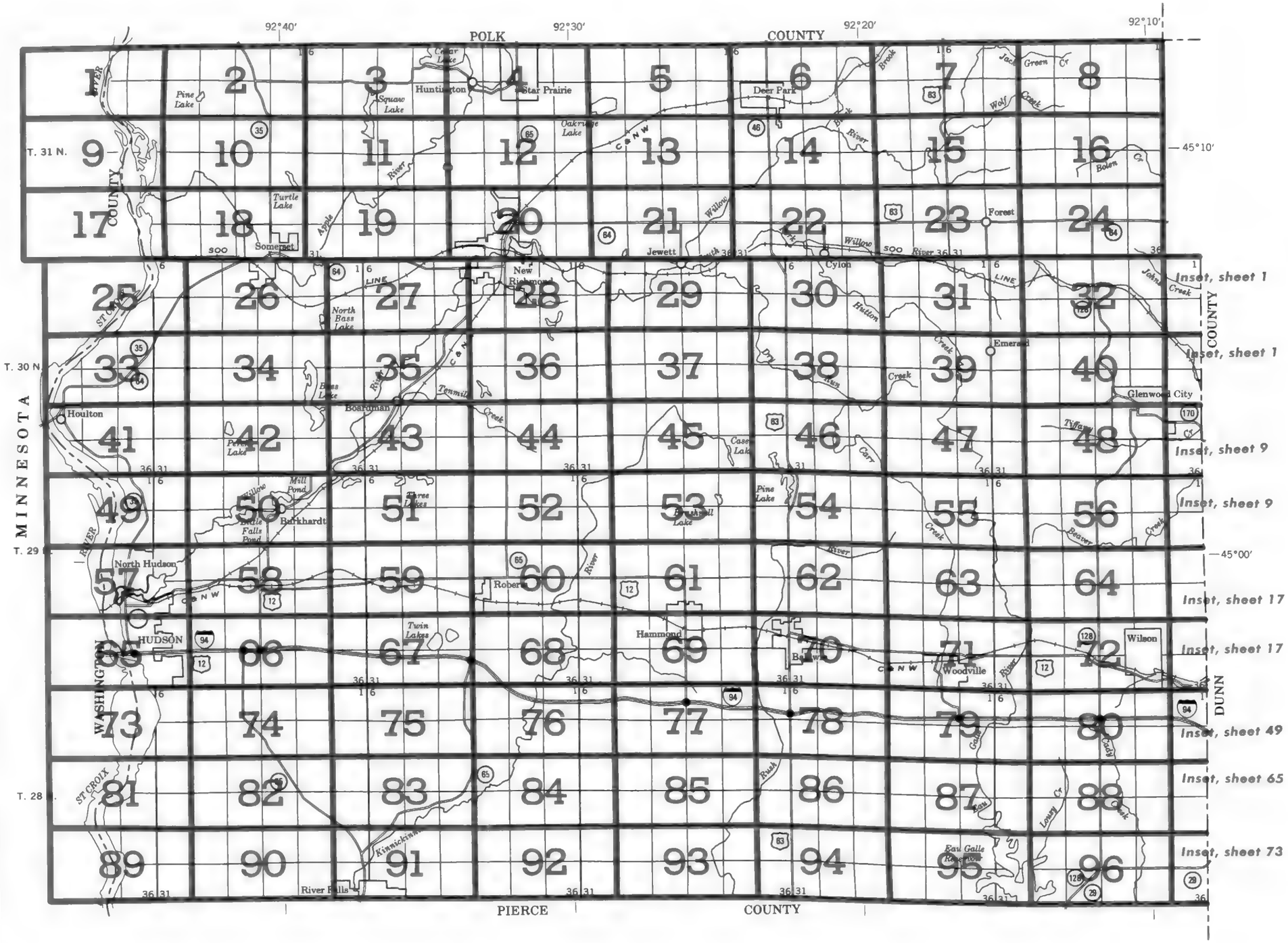
Scale 1:190,080

1 0 1 2 3 4 Miles

N

Original text from each individual map sheet read:

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

SOIL LEGEND

The first capital letter is the initial one of the soil name. The lower case letter that follows separates mapping units having names that begin with the same letter except that it does not separate sloping and eroded phases. A second capital letter, A, B, C, D, E, or F, indicates the slope. Symbols without a slope letter are for soils that are nearly level. A final number 2 in a symbol shows that the soils are eroded.

SYMBOL	NAME
AdA	Adolph silt loam, 0 to 3 percent slopes
AlB	Amery sandy loam, 2 to 6 percent slopes
AlC2	Amery sandy loam, 6 to 12 percent slopes, eroded
AlD2	Amery sandy loam, 12 to 25 percent slopes, eroded
AmB	Amery loam, 2 to 6 percent slopes
AmC2	Amery loam, 6 to 12 percent slopes, eroded
AmD2	Amery loam, 12 to 20 percent slopes, eroded
AmE2	Amery loam, 20 to 30 percent slopes, eroded
AnC2	Amery-Cromwell sandy loams, 6 to 12 percent slopes, eroded
AnD2	Amery-Cromwell sandy loams, 12 to 25 percent slopes, eroded
AoA	Antigo silt loam, 0 to 2 percent slopes
AoB	Antigo silt loam, 2 to 6 percent slopes
ApC2	Arland sandy loam, 6 to 12 percent slopes, eroded
ApD2	Arland sandy loam, 12 to 25 percent slopes, eroded
ApF	Arland sandy loam, 25 to 35 percent slopes
AsB	Arland silt loam, 2 to 6 percent slopes
AsC2	Arland silt loam, 6 to 12 percent slopes, eroded
AuA	Auburndale silt loam, 0 to 3 percent slopes
BnB	Boone loamy fine sand, 2 to 6 percent slopes
BnC	Boone loamy fine sand, 6 to 12 percent slopes
BnD	Boone loamy fine sand, 12 to 20 percent slopes
BpA	Brill silt loam, 0 to 3 percent slopes
BrB	Burkhardt sandy loam, 1 to 6 percent slopes
BrC2	Burkhardt sandy loam, 6 to 12 percent slopes, eroded
BxB	Burkhardt-Sattre complex, 2 to 6 percent slopes
BxC2	Burkhardt-Sattre complex, 6 to 12 percent slopes, eroded
BxD2	Burkhardt-Sattre complex, 12 to 30 percent slopes, eroded
CoC2	Chetek-Onamia complex, 6 to 12 percent slopes, eroded
CoD2	Chetek-Onamia complex, 12 to 20 percent slopes, eroded
CoE	Chetek-Onamia complex, 20 to 30 percent slopes
CyA	Clyde silt loam, 0 to 3 percent slopes
Cz	Cut and fill areas
DaA	Dakota loam, 0 to 2 percent slopes
DaB	Dakota loam, 2 to 6 percent slopes
DcC2	Dakota-Pillot complex, 6 to 12 percent slopes, eroded
DeB	Derinda silt loam, 2 to 6 percent slopes
DeC2	Derinda silt loam, 6 to 12 percent slopes, eroded
DfB	Derinda Variant silt loam, 1 to 6 percent slopes
DkB	Dickman sandy loam, 2 to 6 percent slopes
Du	Duelm loamy sand

SYMBOL	NAME
EmE	Emmert loamy sand, 12 to 35 percent slopes
FdA	Floyd silt loam, 0 to 3 percent slopes
Fe	Fluvaquents
Fm	Fluvaquents, wet
FnB	Freeon silt loam, 2 to 6 percent slopes
FoB	Freeon silt loam, heavy substratum, 2 to 6 percent slopes
FoC2	Freeon silt loam, heavy substratum, 6 to 12 percent slopes, eroded
GoB	Gotham loamy fine sand, 2 to 6 percent slopes
GoC	Gotham loamy fine sand, 6 to 12 percent slopes
Gp	Gravel pits
HaA	Halder silt loam, 0 to 3 percent slopes
HeB	Hesch fine sandy loam, 2 to 6 percent slopes
HeC2	Hesch fine sandy loam, 6 to 12 percent slopes, eroded
HeD2	Hesch fine sandy loam, 12 to 20 percent slopes, eroded
HrB	Hubbard loamy sand, 0 to 6 percent slopes
HsB	Hubbard loamy sand, loamy substratum, 0 to 6 percent slopes
HsC	Hubbard loamy sand, loamy substratum, 6 to 12 percent slopes
HuA	Huntsville silt loam, 0 to 3 percent slopes
JeA	Jewett silt loam, 0 to 2 percent slopes
JeB	Jewett silt loam, 2 to 6 percent slopes
JeC2	Jewett silt loam, 6 to 12 percent slopes, eroded
JsA	Jewett silt loam, sandy substratum, 0 to 2 percent slopes
JsB	Jewett silt loam, sandy substratum, 2 to 6 percent slopes
LcA	Lawler silt loam, 0 to 3 percent slopes
MaB	Magnor silt loam, 1 to 6 percent slopes
NcB	Nickin silt loam, 2 to 6 percent slopes
NcC2	Nickin silt loam, 6 to 12 percent slopes, eroded
NnD2	Nickin loam, 12 to 20 percent slopes, eroded
OmB	Onamia loam, 2 to 6 percent slopes
OmC2	Onamia loam, 6 to 12 percent slopes, eroded
OnC2	Onamia-Antigo complex, 6 to 12 percent slopes, eroded
OnD2	Onamia-Antigo complex, 12 to 25 percent slopes, eroded
OrA	Orion silt loam, 0 to 3 percent slopes
OtB	Otterholt silt loam, 2 to 6 percent slopes
OtC	Otterholt silt loam, 6 to 12 percent slopes
OtD2	Otterholt silt loam, 12 to 20 percent slopes, eroded

SYMBOL	NAME
PlA	Pillot silt loam, 0 to 3 percent slopes
PmB	Plainfield loamy sand, 2 to 6 percent slopes
PmC	Plainfield loamy sand, 6 to 12 percent slopes
PmD	Plainfield loamy sand, 12 to 20 percent slopes
PoB	Port Byron silt loam, 2 to 6 percent slopes
PoC	Port Byron silt loam, 6 to 12 percent slopes
PoD	Port Byron silt loam, 12 to 20 percent slopes
ReB	Renova silt loam, 2 to 6 percent slopes
ReC2	Renova silt loam, 6 to 12 percent slopes, eroded
RgC2	Renova Variant loam, 4 to 12 percent slopes, eroded
RgD2	Renova Variant loam, 12 to 20 percent slopes, eroded
RhA	Rib silt loam, 0 to 3 percent slopes
RnB	Ritchey silt loam, 2 to 6 percent slopes
RnC2	Ritchey silt loam, 6 to 12 percent slopes, eroded
RnD2	Ritchey silt loam, 12 to 20 percent slopes, eroded
RoE	Ritchey soils and Rock outcrop, 20 to 35 percent slopes
RpB	Rockton silt loam, 2 to 6 percent slopes
RpC2	Rockton silt loam, 6 to 12 percent slopes, eroded
RpD2	Rockton silt loam, 12 to 20 percent slopes, eroded
SaB	Santiago silt loam, 2 to 6 percent slopes
SaC2	Santiago silt loam, 6 to 12 percent slopes, eroded
ScC2	Santiago-Antigo complex, 6 to 12 percent slopes, eroded
ScD2	Santiago-Antigo complex, 12 to 25 percent slopes, eroded
Se	Saprists and Aquents
ShA	Sattre loam, 0 to 2 percent slopes
ShB	Sattre loam, 2 to 6 percent slopes
ShC2	Sattre loam, 6 to 12 percent slopes, eroded
SlA	Sattre silt loam, 0 to 2 percent slopes
SlB	Sattre silt loam, 2 to 6 percent slopes
Sm	Seelyeville muck
SrA	Skyberg silt loam, 0 to 3 percent slopes
Ud	Udifluvents
VaB	Vlasaty silt loam, 2 to 6 percent slopes
VaC2	Vlasaty silt loam, 6 to 12 percent slopes, eroded
WhB	Whalan silt loam, 2 to 6 percent slopes
WhC2	Whalan silt loam, 6 to 12 percent slopes, eroded
WhD2	Whalan silt loam, 12 to 25 percent slopes, eroded

ST. CROIX COUNTY, WISCONSIN

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline & neatline

AD HOC BOUNDARY (label)

- Small airport, airfield, park, oilfield, cemetery, or flood pool

STATE COORDINATE TICK

LAND DIVISION CORNERS (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEMS & DESIGNATIONS

- Interstate
- Federal
- State
- County, farm or ranch

RAILROAD

POWER TRANSMISSION LINE (normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or small

PITS

- Gravel pit
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School
- Indian mound (label)
- Located object (label)
- Tank (label)
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
  - Double-line (label)
  - Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial
- Intermittent

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

GULLY

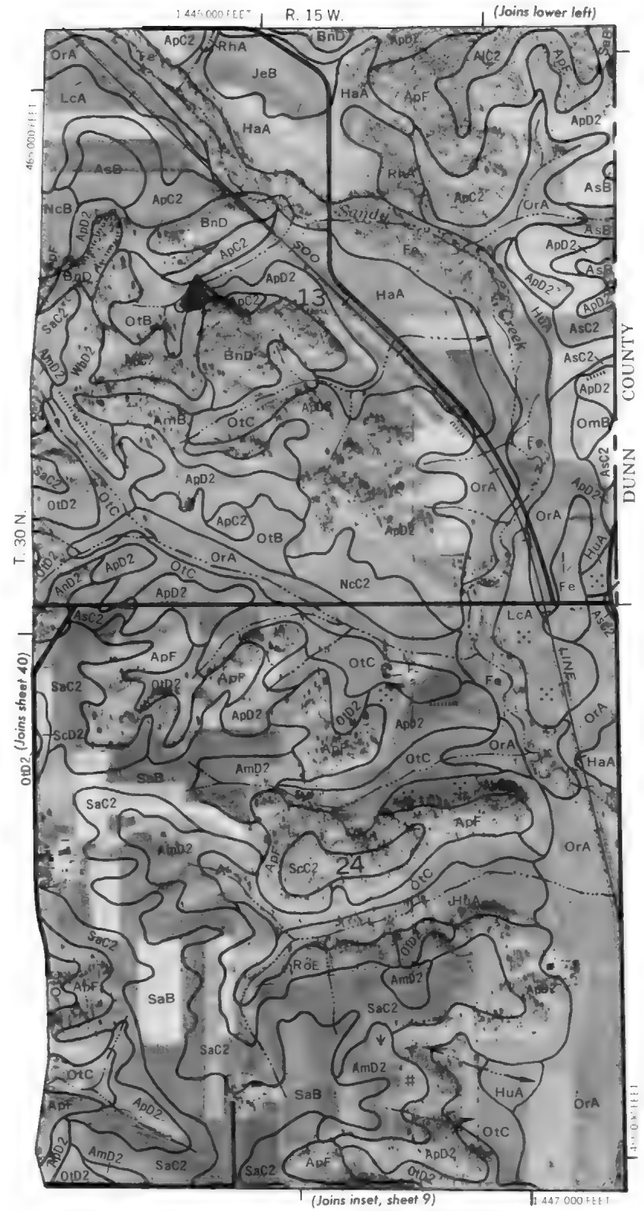
DEPRESSION OR SINK

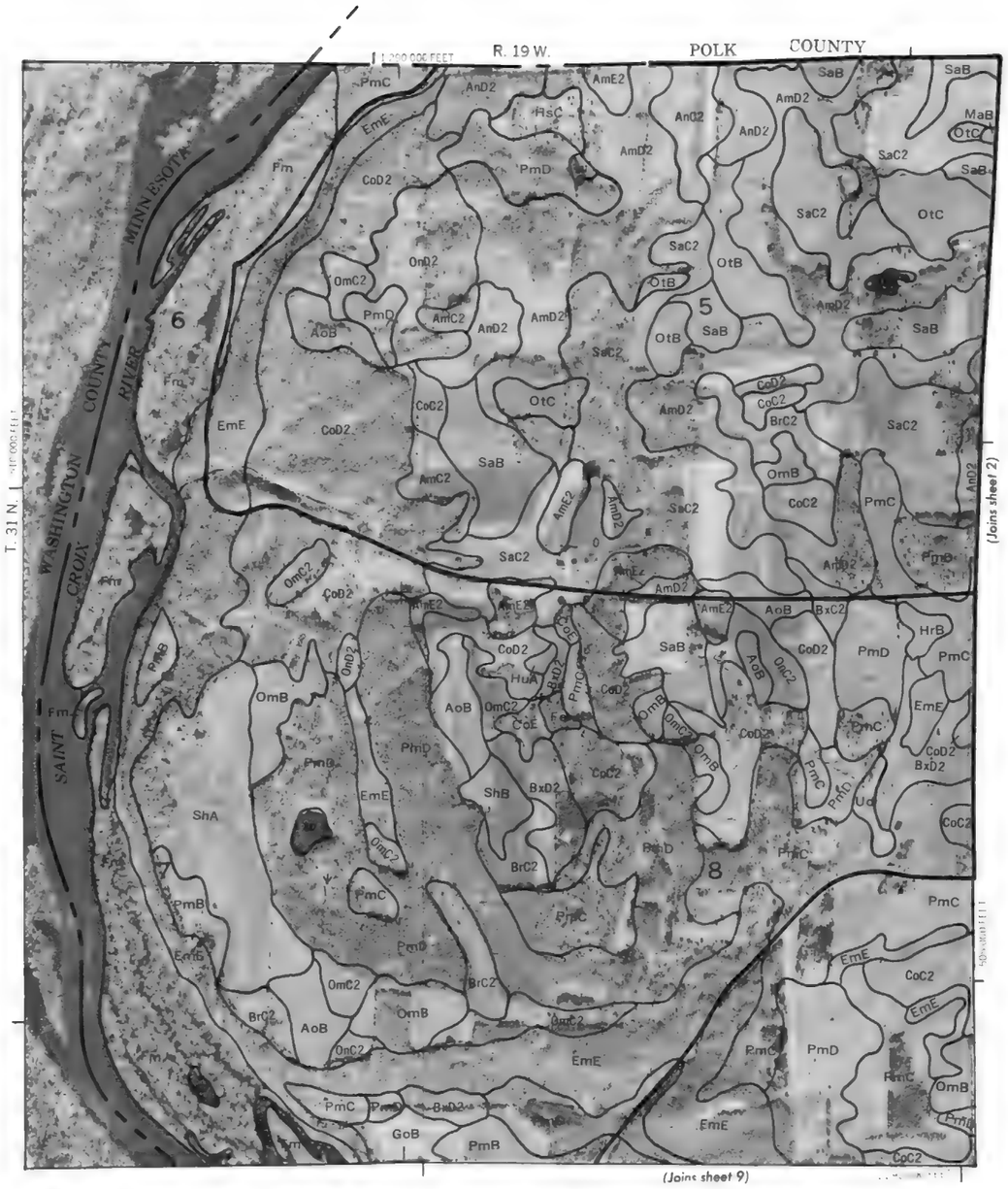
SOIL SAMPLE SITE (normally not shown)

MISCELLANEOUS

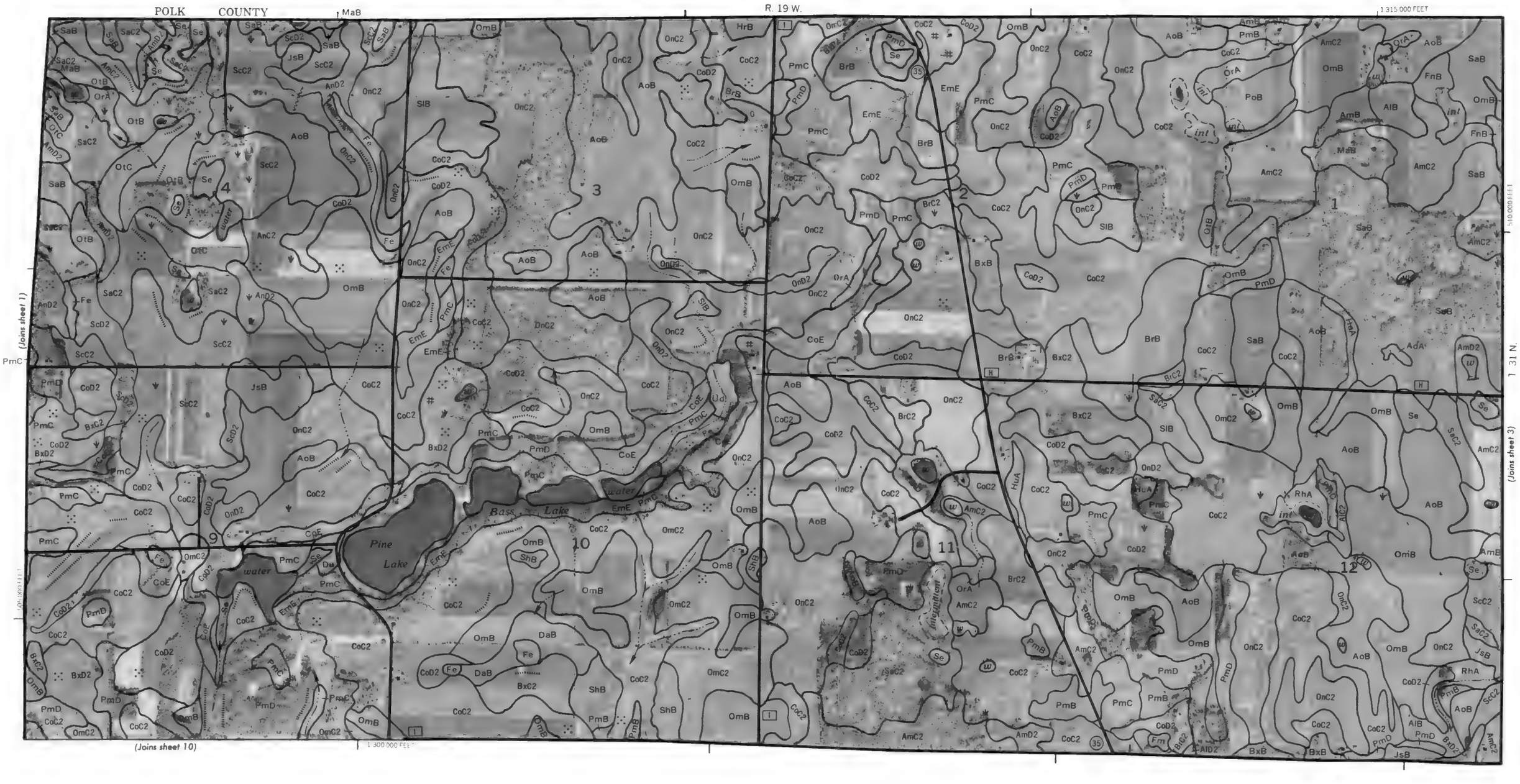
- Blowout
- Clay spot
- Gravelly spot
- Gumbo, slick or scabby spot (sodic)
- Dumps and other similar non soil areas
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Sandy spot
- Severely eroded spot
- Slide or slip (tips point upslope)
- Stony spot, very stony spot
- Cut and fill acres 10 acres or less


R. 15 W.
DUNN COUNTY
T. 30 N.
(Joins sheet 32)
(Joins upper right)
2000 AND 5000-FOOT GRID TICKS


R. 15 W.
(Joins lower left)
DUNN COUNTY
T. 30 N.
(Joins sheet 40)
(Joins inset, sheet 9)
2000 AND 5000-FOOT GRID TICKS


R. 19 W.
POLK COUNTY
WASHINGTON COUNTY
MINNESOTA
RIVER
T. 31 N.
SAINT CROIX
(Joins sheet 2)
(Joins sheet 9)


N
1 Mile
5 000 Feet
Scale 1:15 840


POLK COUNTY
R. 19 W.
1 315 000 FEET
10 000 FEET
T. 31 N.
(Joins sheet 1)
(Joins sheet 3)
(Joins sheet 10)
1 300 000 FEET
Pine Lake
Bass Lake
water
Scale 1:15 840
1 Mile
5 000 Feet


1 320 000 FEET
POLK COUNTY
R. 18 W.
T. 31 N.
510 000 FEET
Cedar Lake
Squaw Lake
water
(Joins sheet 2)
(Joins sheet 4)
(Joins sheet 11)
1 320 000 FEET
1 Mile
5 000 Feet
Scale 1:15 840


POLK COUNTY
R. 18 W.
R. 17 W.
T. 31 N.
1 356 000 FEET
510 000 FEET
1 340 000 FEET
(Joins sheet 3)
(Joins sheet 5)
(Joins sheet 12)
Cedar Lake
Cedar Creek
Apple River
Intermittent
Huntington
Star Prairie
water
1 Mile
5 000 Feet
Scale 1:15 840
0
¼
½
¾
1
1 000
2 000
3 000
4 000
5 000


1 360 000 FEET
R. 17 W.
POLK COUNTY
510 000 FEET
T. 31 N.
(Joins sheet 4)
(Joins sheet 6)
(Joins sheet 13)
Oak Ridge Lake
water
1 Mile
5 000 Feet
Scale 1:15 840

6

N

POLK COUNTY

R. 16 W.

1 : 400 000 FEET

T. 31 N.

1 Mile

5 000 Feet

Scale 1:15 840

1 380 000 FEET

(Joins sheet 5)

(Joins sheet 7)

(Joins sheet 14)

Deer Park

CHICAGO

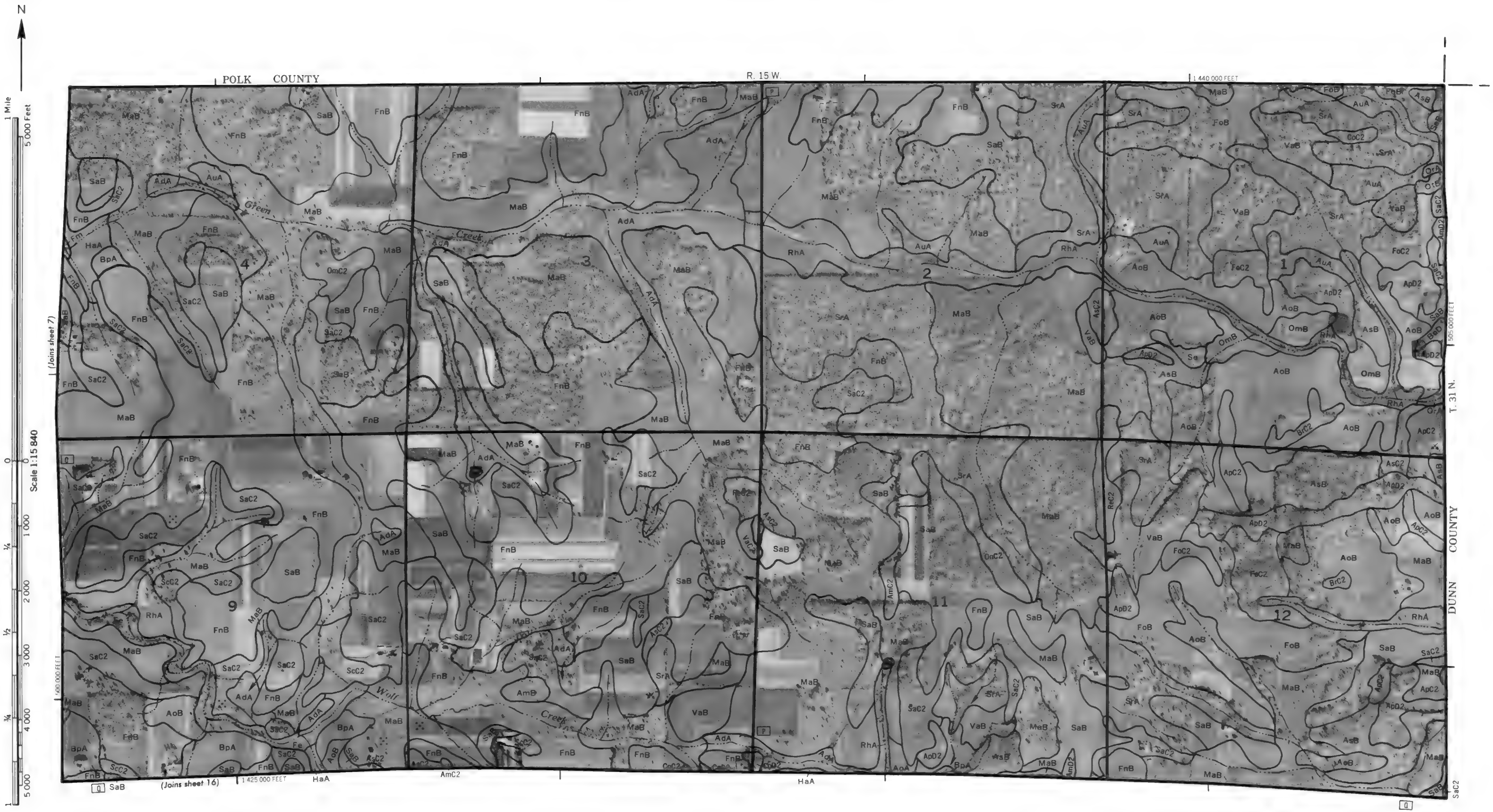
Black Brook

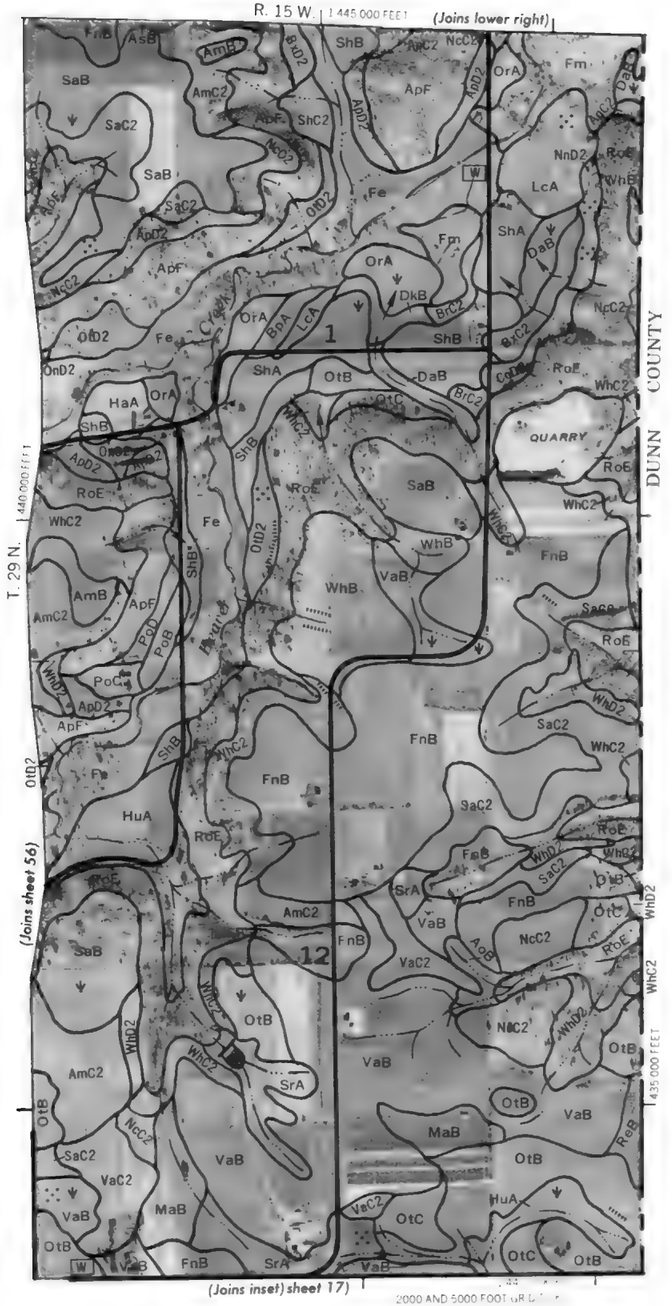
NORTHWESTERN

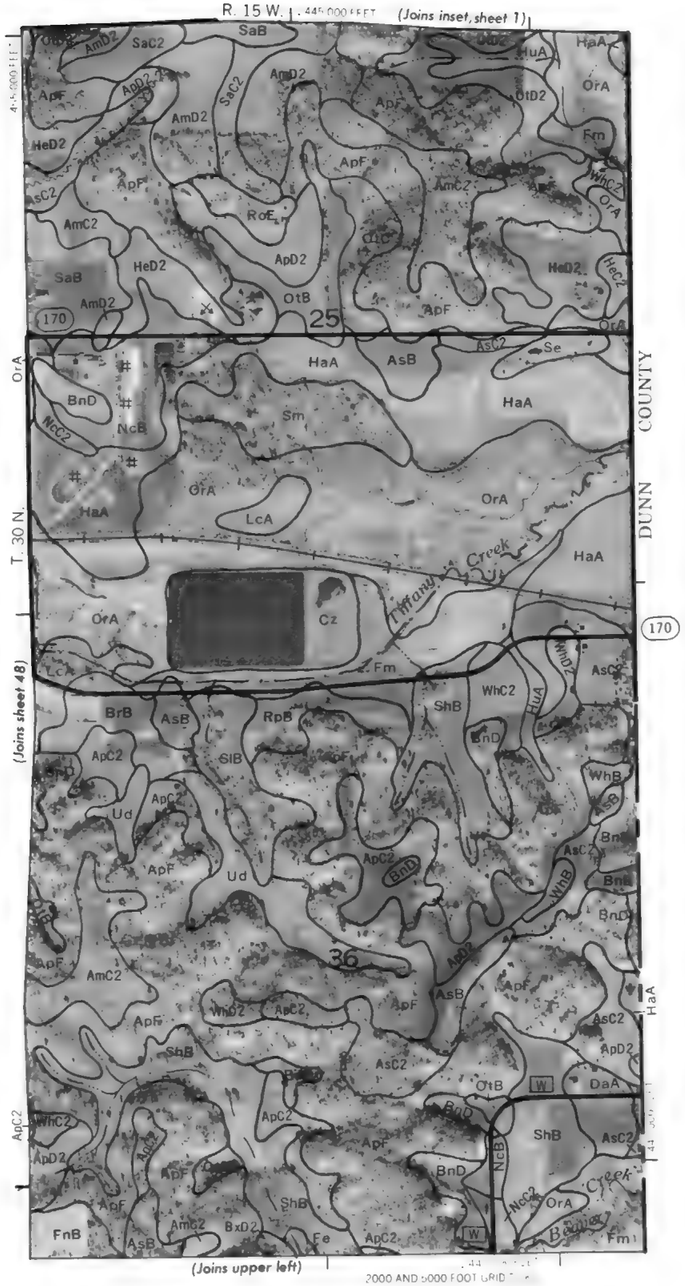
Fm

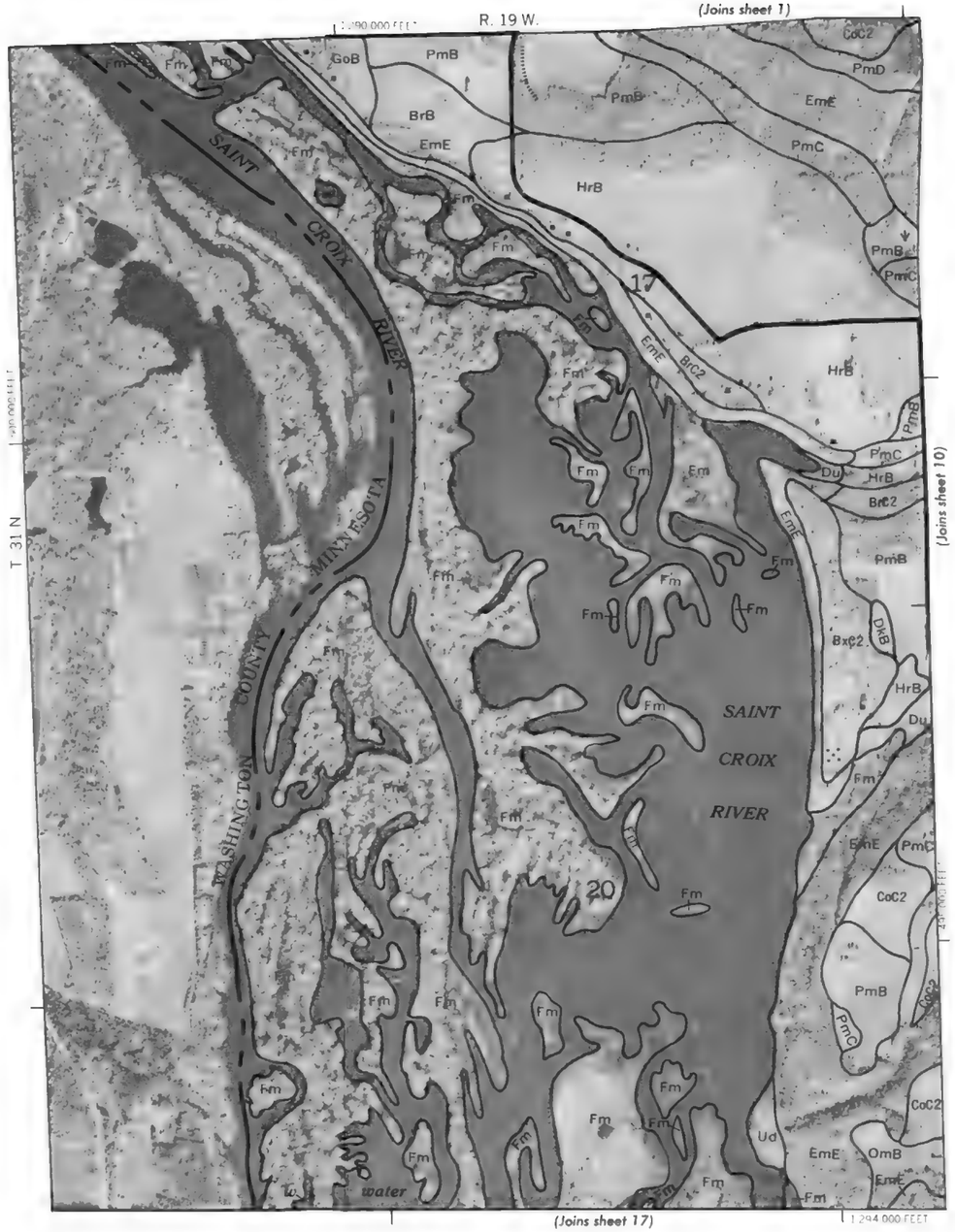
water


N
POLK COUNTY
R. 16 W. | R. 15 W.
T. 31 N.
(Joins sheet 6)
(Joins sheet 8)
(Joins sheet 15)
Harmin Lake
Black Brook
Willow River
Greek Creek
63
1 Mile
5 000 Feet
Scale 1:15 840
0
1 000
2 000
3 000
4 000
5 000
¼
½
¾


N
POLK COUNTY
R. 15 W.
1 440 000 FEET
T. 31 N.
DUNN COUNTY
505 000 FEET
(Joins sheet 7)
(Joins sheet 16)
1 425 000 FEET
400 000 FEET
Green Creek
Wolf Creek
Scale 1:15 840
1 Mile
5 000 Feet
0
1/4
1/2
3/4
1000
2000
3000
4000
5 000
1
2
3
4
9
10
11
12







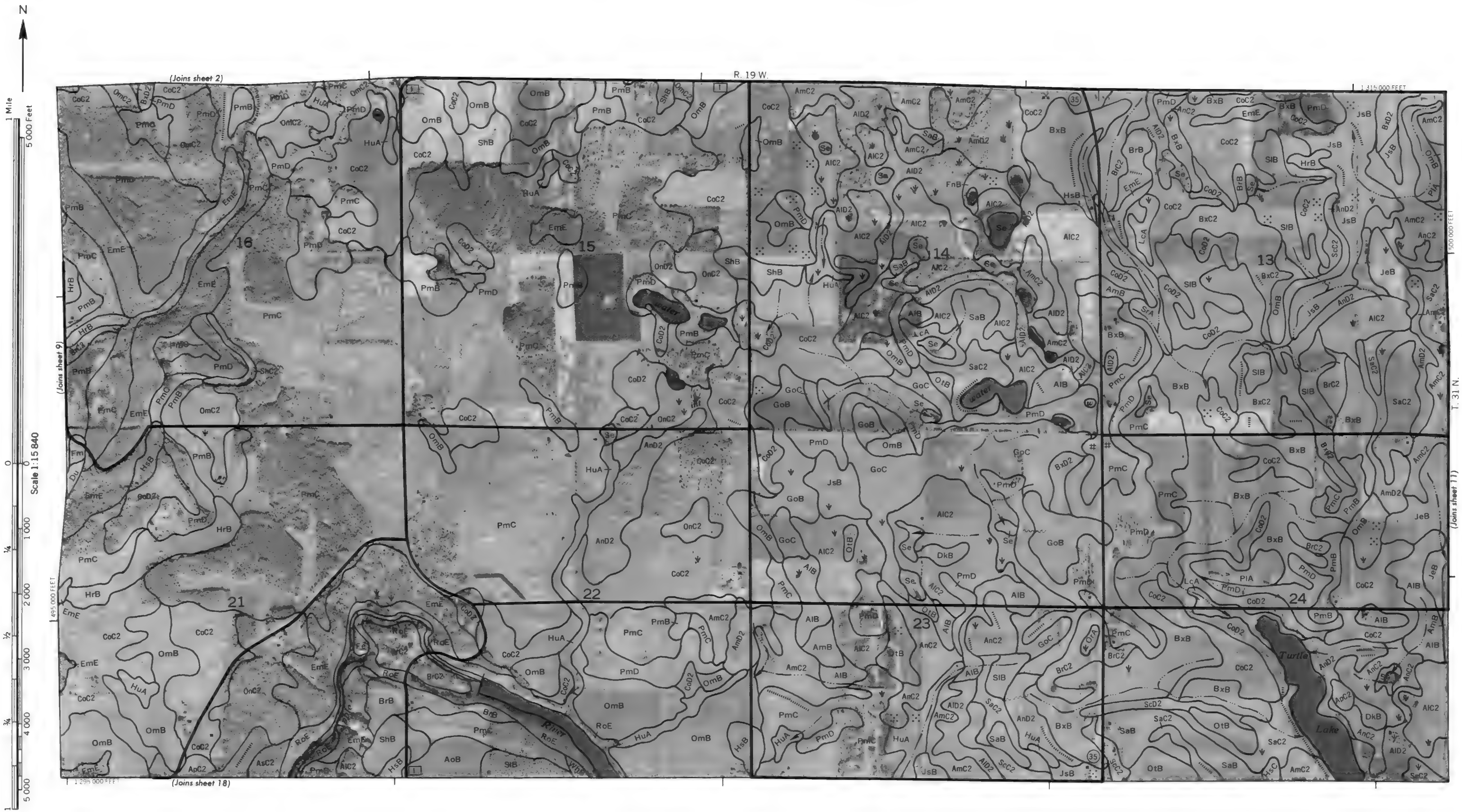
9

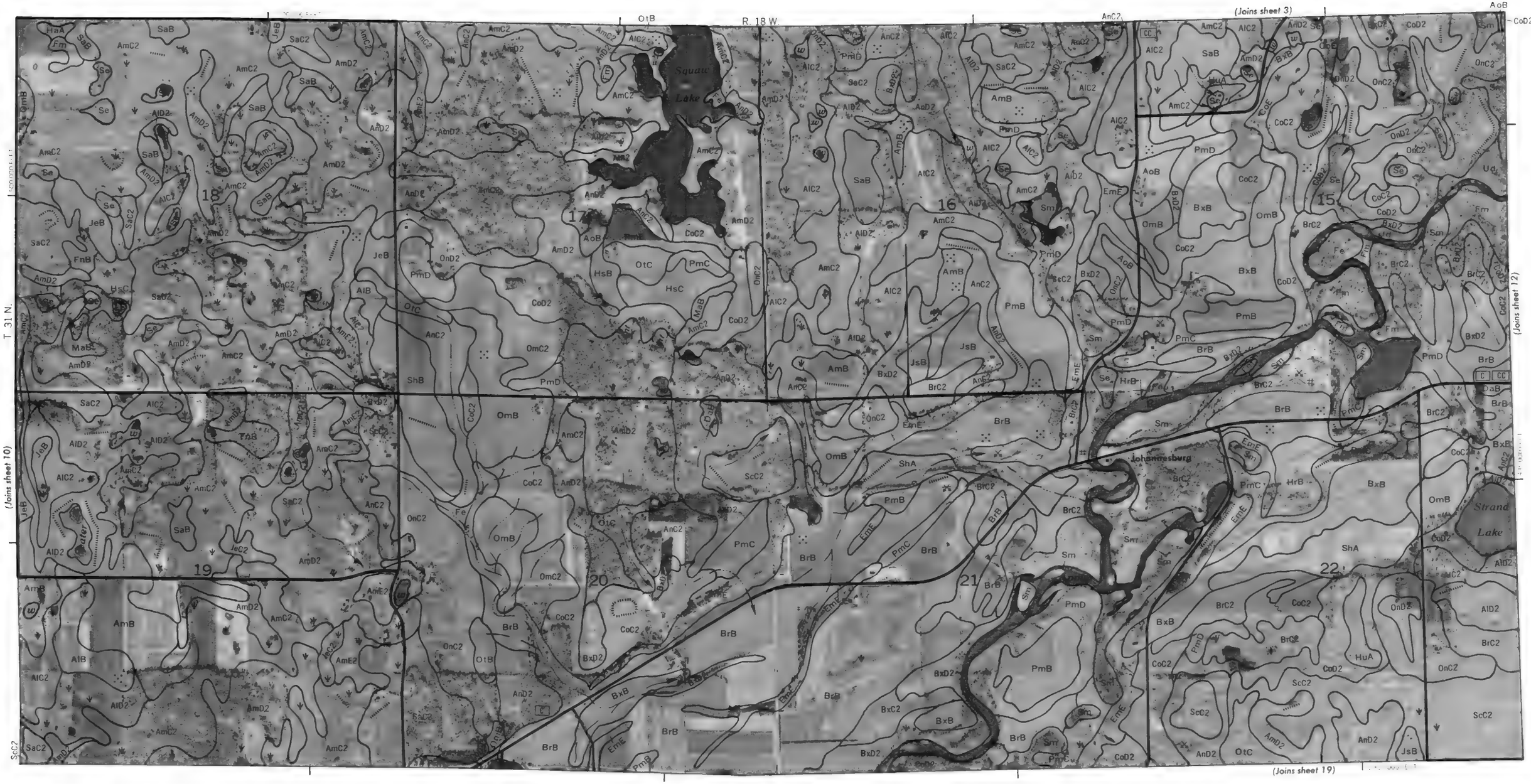
N

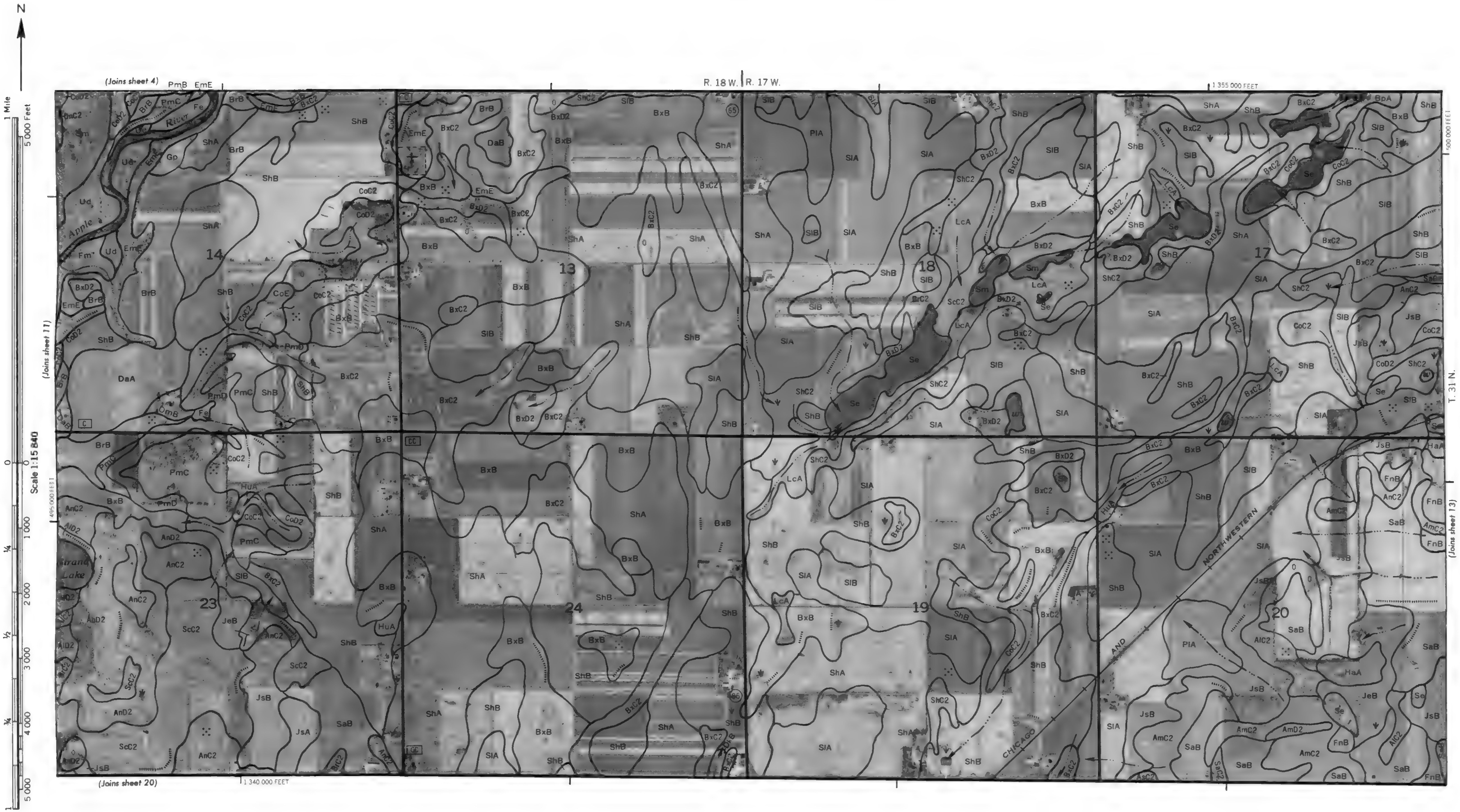
1 Mile

5 000 Feet

Scale 1:15 840


N
1 Mile
5 000 Feet
0
Scale 1:15 840
1 000
2 000
3 000
4 000
5 000
¼
½
¾
(Joins sheet 2)
R. 19 W.
(Joins sheet 9)
(Joins sheet 11)
(Joins sheet 18)
T. 31 N.
1 415 000 FEET
500 000 FEET
495 000 FEET
1 295 000 FEET
16
15
14
13
21
22
23
24
water
River
Turtle
Lake
35


R. 18 W.
T. 31 N.
(Joins sheet 3)
(Joins sheet 12)
(Joins sheet 10)
(Joins sheet 19)
Squaw Lake
Johannesburg
Strand Lake
Scale 1:15 840
1 Mile
5 000 Feet
N
11


N
(Joins sheet 4)
R. 18 W.
R. 17 W.
1 355 000 FEET
500 000 FEET
(Joins sheet 11)
(Joins sheet 13)
(Joins sheet 20)
1 340 000 FEET
495 000 FEET
T. 31 N.
Scale 1:15 840
1 Mile
5 000 Feet
14
13
18
17
23
24
19
20
Apple River
Strand Lake
CHICAGO AND NORTHWESTERN


1 360 000 FEET
500 000 FEET
R. 17 W.
T. 31 N.
(Joins sheet 5)
(Joins sheet 12)
(Joins sheet 14)
(Joins sheet 21)
NORTHWESTERN
CHICAGO AND
Shingleton
water
13
14
15
16
21
22
23
24
1 Mile
5 000 Feet
N
Scale 1:15 840

14

N

1 Mile

5 000 Feet

Scale 1:15 840

0 0 ¼ ½ ¾ 1

1 000 2 000 3 000 4 000 5 000

15

N

1 Mile

5 000 Feet

Scale 1:15 840

0 1/4 1/2 3/4 1

1 000 2 000 3 000 4 000 5 000

16

N

1 Mile

5 000 Feet

Scale 1:15 840

0 0

¼ 1 000

½ 2 000

¾ 3 000

1 4 000

1¼ 5 000

R. 15 W.

1 440 000 FEET

490 000 FEET

485 000 FEET

T. 31 N.

DUNN COUNTY

(Joins sheet 8)

(Joins sheet 15)

(Joins sheet 24)

1 425 000 FEET

16

15

14

13

21

22

23

24

Immanuel Church

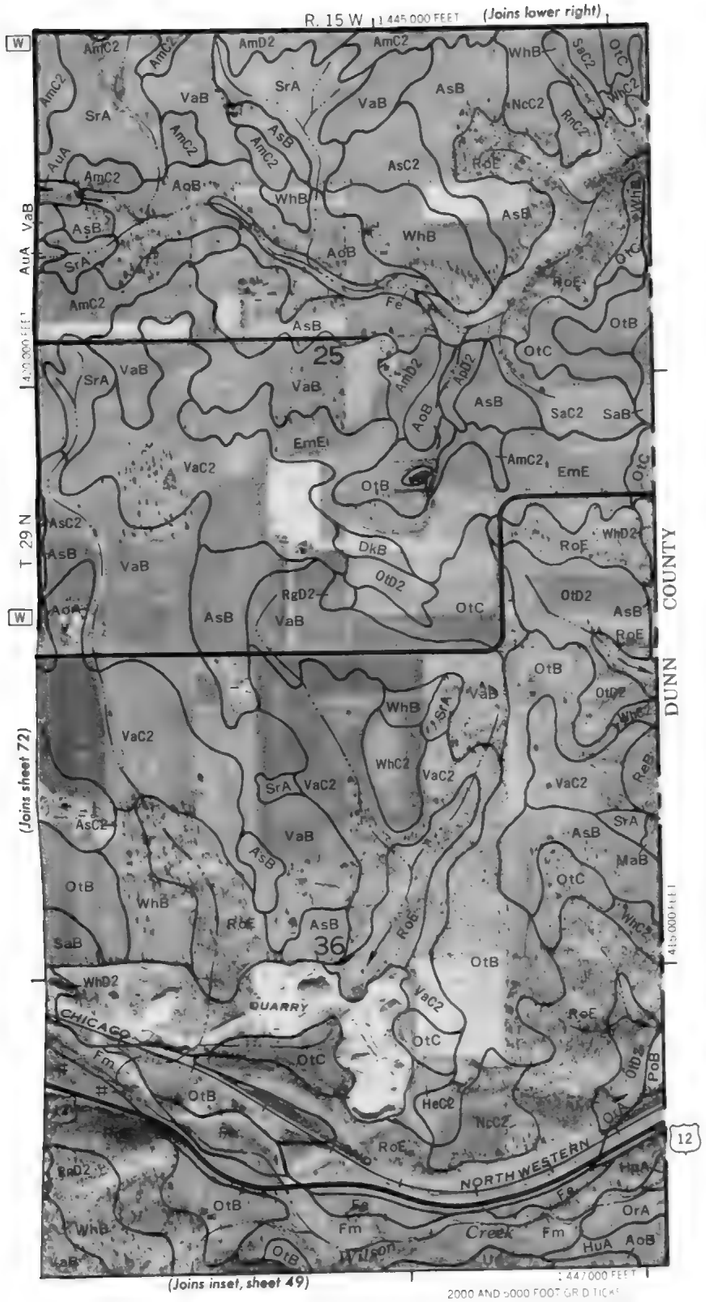
Boten

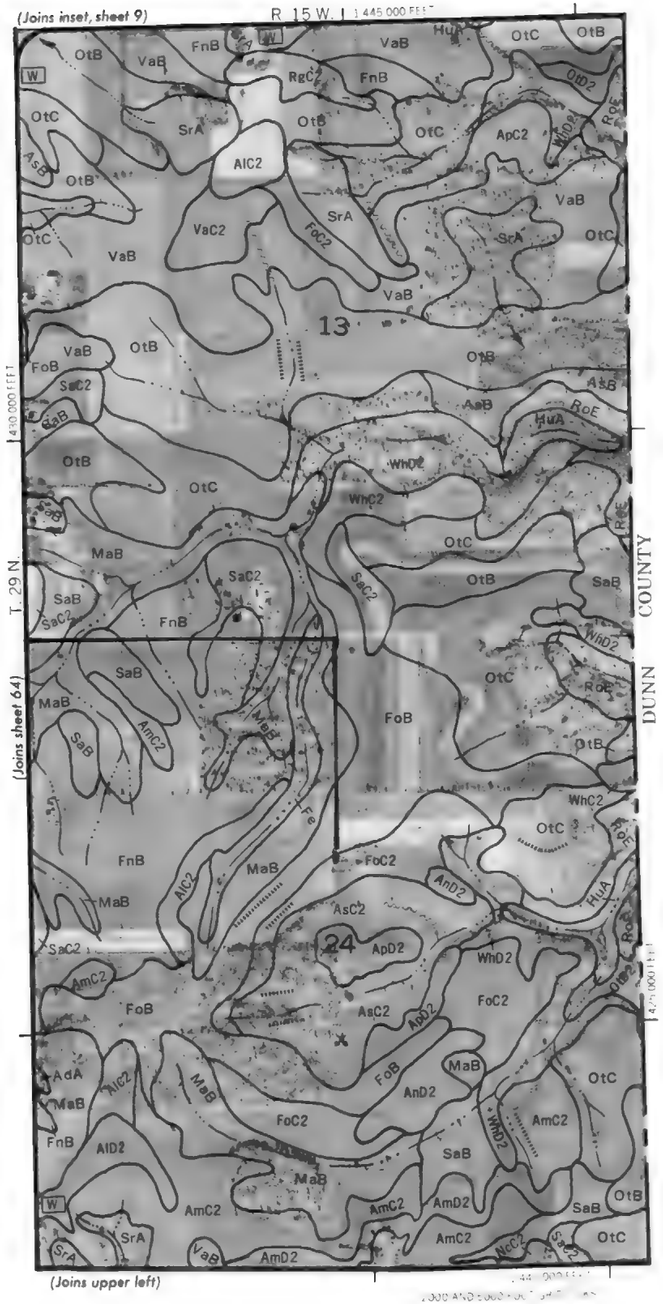
Creek

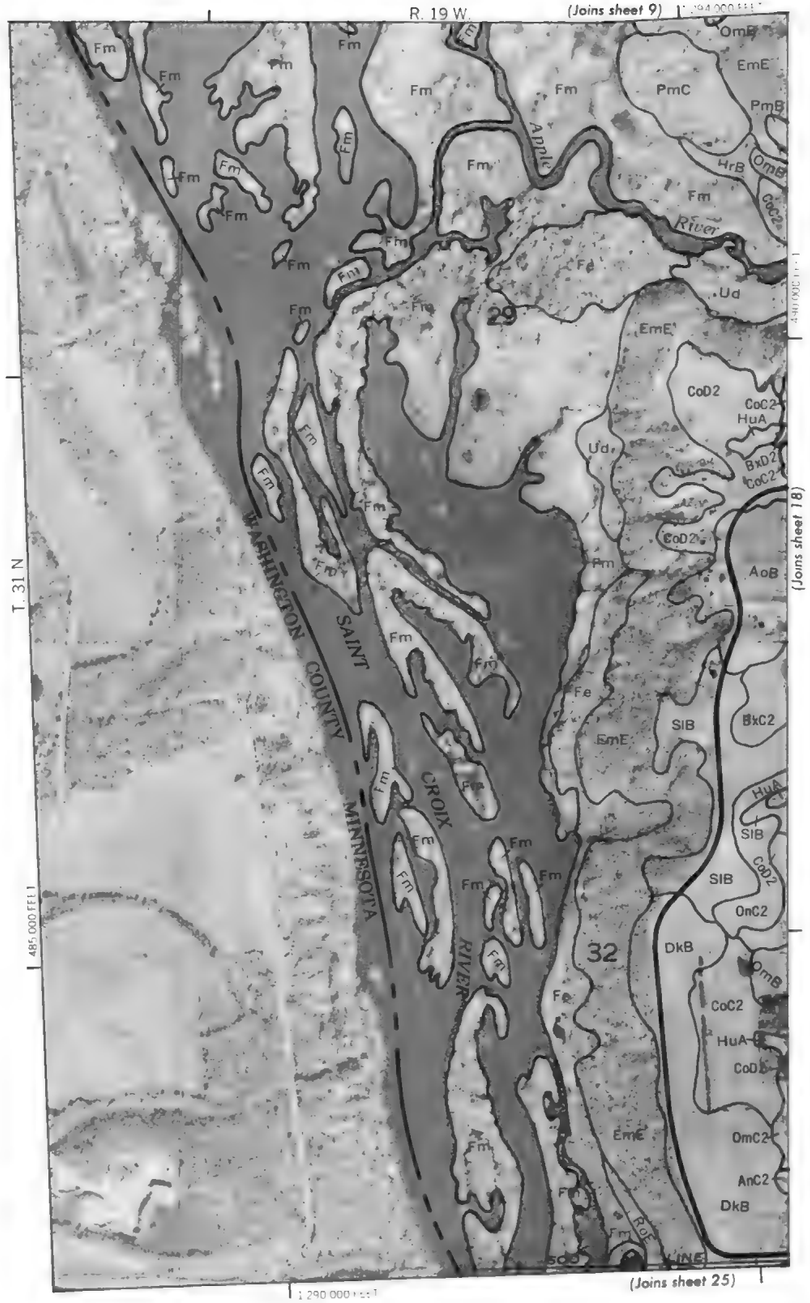
Fm

Q

P

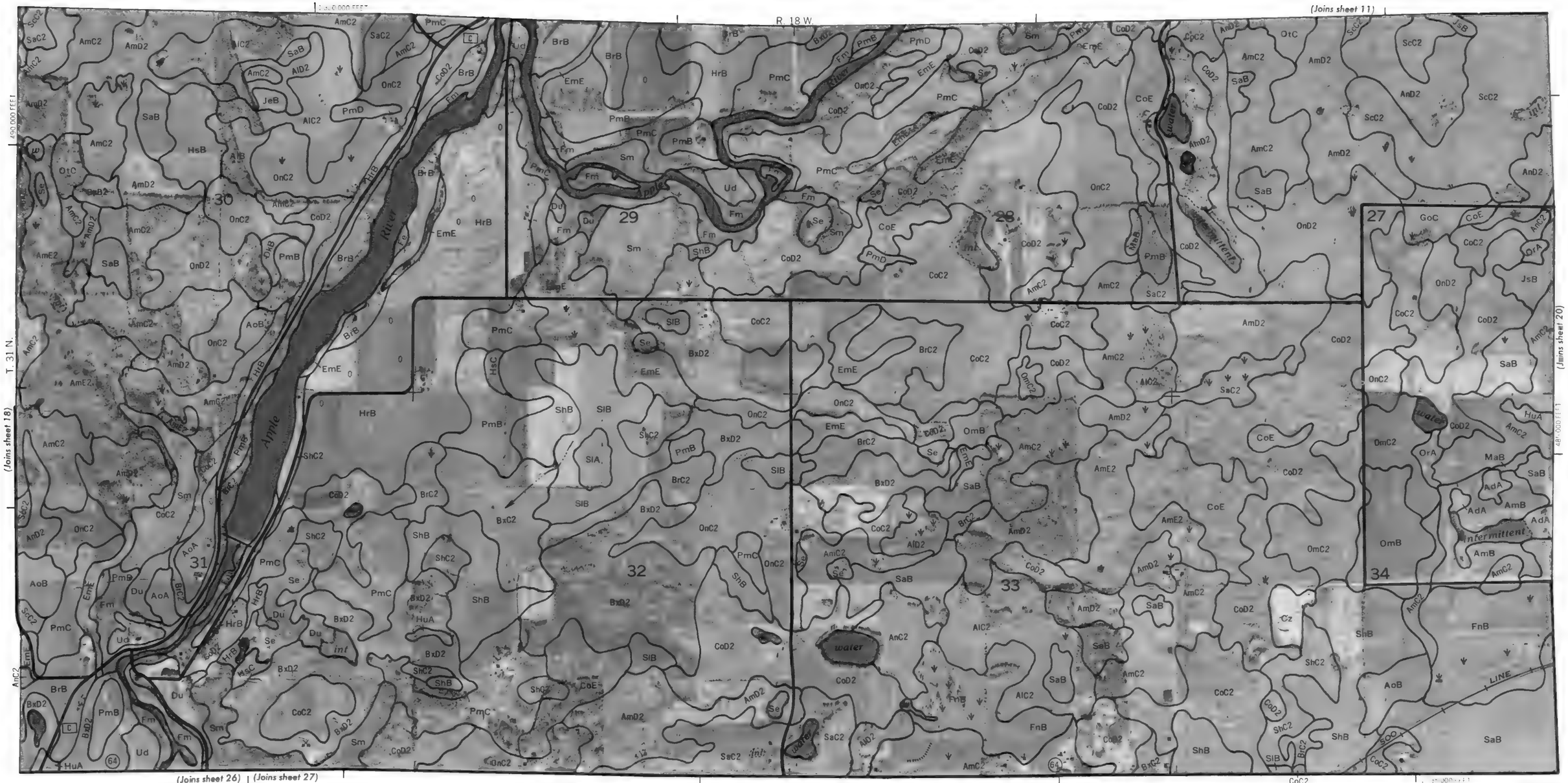

R. 15 W.
(Joins lower right)
T. 29 N.
25
36
DUNN COUNTY
QUARRY
CHICAGO
NORTHWESTERN
Wilson Creek
(Joins sheet 72)
(Joins inset, sheet 49)


(Joins inset, sheet 9)
R. 15 W.
T. 29 N.
13
24
DUNN COUNTY
(Joins sheet 64)
(Joins upper left)


R. 19 W.
(Joins sheet 9)
T. 31 N.
29
32
WASHINGTON COUNTY
SAINT CROIX
MINNESOTA
RIVER
Apple River
(Joins sheet 18)
(Joins sheet 25)


1 Mile
5 000 Feet
Scale 1:15 840


(18)
N
1 Mile
5 000 Feet
Scale 1:15 840
0
¼
½
¾
1
1 000
2 000
3 000
4 000
5 000
(Joins sheet 10)
R. 19 W.
1 315 000 FEET
490 000 FEET
485 000 FEET
1 295 000 FEET
T. 31 N.
(Joins sheet 17)
(Joins sheet 19)
(Joins sheet 25)
(Joins sheet 26)
Apple River
EmE River
LINE
Somerset
25
26
27
28
33
34
35
36


R. 18 W.
T. 31 N.
490,000 FEET
48,000 FEET
(Joins sheet 11)
(Joins sheet 18)
(Joins sheet 20)
(Joins sheet 26)
(Joins sheet 27)
Apple River
Apple
Willow River
Intermittent
water
LINE
29
30
31
32
33
34
28
27
AmC2
AmD2
AmE2
AnD2
AoA
AoB
BrB
BrC2
BxD2
CoC2
CoD2
CoE
Cz
EmE
FnB
Fm
GoC
HrB
HsC
HuA
JeB
JsB
MaB
OmB
OmC2
OnC2
OnD2
OrA
PmB
PmC
PmD
SaB
SaC2
ScC2
ScD2
Se
ShB
ShC2
SIB
SIC2
Sm
Ud
Du
int
1 Mile
5,000 Feet
Scale 1:15 840

20

N

1 Mile 5 000 Feet

Scale 1:15 840

0 0 1/4 1/2 3/4 1

1 000 2 000 3 000 4 000 5 000

485 000 FEET

(Joins sheet 12)

(Joins sheet 19)

R. 18 W. | R. 17 W.

1 355 000 FEET

460 000 FEET

T. 31 N.

(Joins sheet 21)

1 340 000 FEET

(Joins sheet 27) | (Joins sheet 28)

NEW RICHMOND

New Richmond Airport

Hatfield Lake

NORTHWESTERN LINE

CHICAGO AND

Willow River

water

25 26 29 30 31 32 35 36

N

R. 17 W.

T. 31 N.

(Joins sheet 13)

(Joins sheet 20)

(Joins sheet 22)

(Joins sheet 28) (Joins sheet 29)

1 Mile 5 000 Feet

Scale 1:15 840

22

N

1 Mile

5 000 Feet

Scale 1:15 840

0 6 1 000 2 000 3 000 4 000 5 000

1 ¼ ½ ¾

(Joins sheet 14)

R. 16 W.

1 400 000 FEET

480 000 FEET

T. 31 N.

(Joins sheet 21)

(Joins sheet 23)

1 380 000 FEET

(Joins sheet 29) | (Joins sheet 30)

Willow River

South Fork Willow River

North Fork Willow River

LINE

HOLY ROSARY CEMETERY

30 29 28 27 31 32 33 34

N

1 Mile

5 000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1

1 000 2 000 3 000 4 000 5 000

1 405 000 FEET

R. 16 W. | R. 15 W.

T. 31 N.

(Joins sheet 15)

(Joins sheet 22)

(Joins sheet 24)

(Joins sheet 31)

25 26 29 30 31 32 35 36

SOO LINE

63 64


24
N
1 Mile
5 000 Feet
Scale 1:15 840
0
¼
½
¾
1 000
2 000
3 000
4 000
5 000
(Joins sheet 16)
R. 15 W.
HuA
1 440 000 FEET
485 000 FEET
T. 31 N.
DUNN COUNTY
480 000 FEET
(Joins sheet 23)
(Joins sheet 32)
1 425 000 FEET
128
AoB
VaC2
St. Johns Church
64
28
27
26
25
33
34
35
36

ST. CROIX COUNTY, WISCONSIN — SHEET NUMBER 25

25

26

N

1 Mile

5 000 Feet

Scale 1:15 840

1 000 0 1 000 2 000 3 000 4 000 5 000

R. 19 W.

T. 30 N.

(Joins sheet 25)

(Joins sheet 18) | (Joins sheet 19)

(Joins sheet 27)

AmD2 (Joins sheet 34)

1 300 000 FEET

Somerset

Apple River

North Bass Lake

water

LINE

27

N

1 Mile

5 000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1 000 2 000 3 000 4 000 5 000

1 320 000 FEET

480 000 FEET

R. 19 W. | R. 18 W.

T. 30 N

(Joins sheet 19)

(Joins sheet 20)

(Joins sheet 26)

(Joins sheet 28)

(Joins sheet 35)

LINE

Willow River

Pamerjack Creek

28

N

1 Mile

5 000 Feet

Scale 1:15 840

R. 18 W. | R. 17 W.

(Joins sheet 20) (Joins sheet 21)

1 360 000 FEET

T. 30 N.

NEW RICHMOND

Willow River

Willow Creek

Paper Creek

Jack Creek

Lucas Creek

Brushy Mound Lake

NORTHWESTERN

SOO LINE

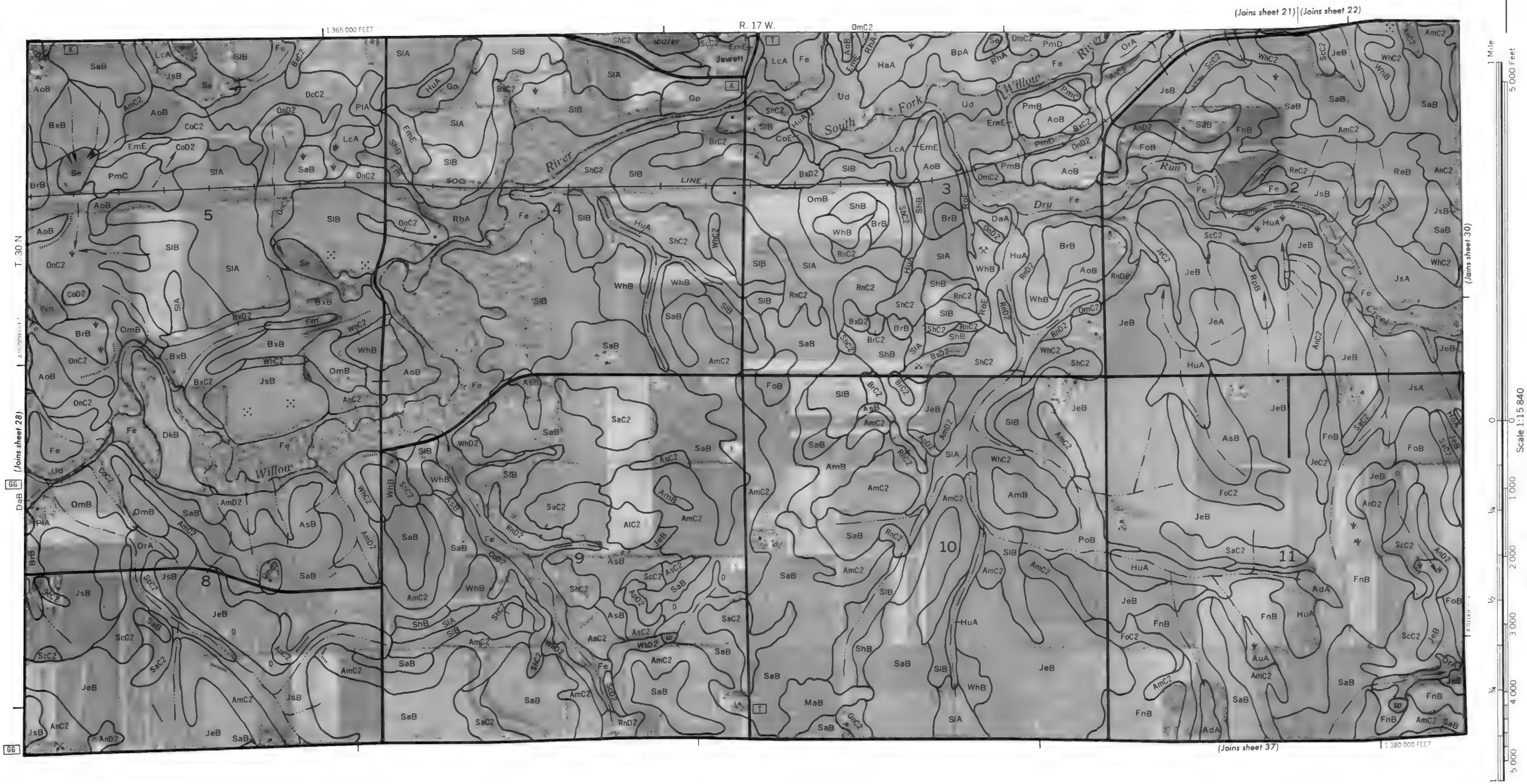
CHICAGO AND ...

1 340 000 FEET

(Joins sheet 36)

(Joins sheet 27)

(Joins sheet 29)


N
R. 17 W.
T. 30 N
1 365 000 FEET
1 380 000 FEET
(Joins sheet 21)
(Joins sheet 22)
(Joins sheet 28)
(Joins sheet 30)
(Joins sheet 37)
Jewett
water
South Fork
Willow River
Willow
Dry Run
Creek
SOO LINE
2
3
4
5
8
9
10
11
1 Mile
5 000 Feet
Scale 1:15 840

30

N

1 Mile

5 000 Feet

Scale 1:15 840

R. 17 W. | R. 16 W.

(Joins sheet 29)

(Joins sheet 22) | (Joins 23)

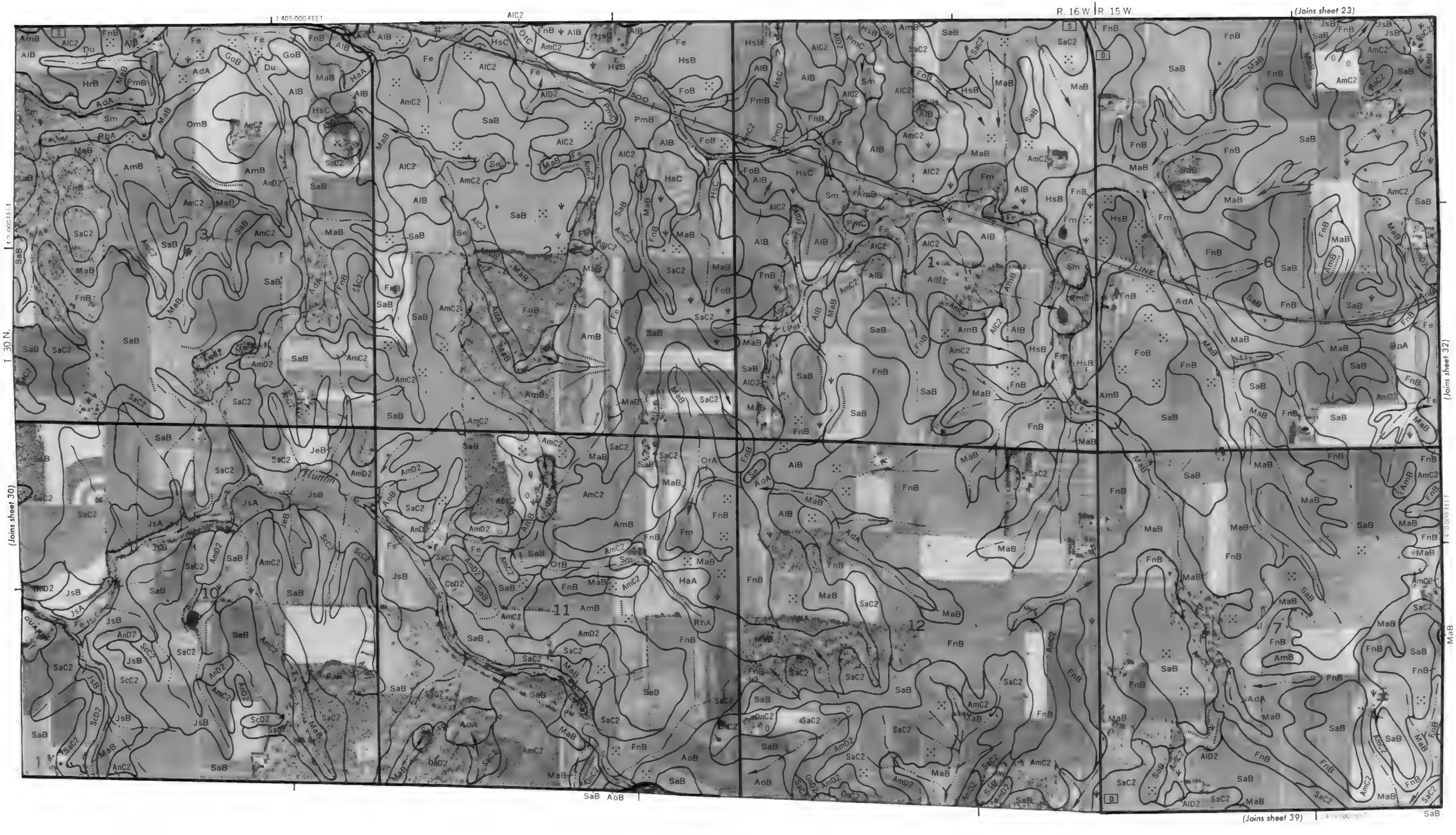
(Joins sheet 38)

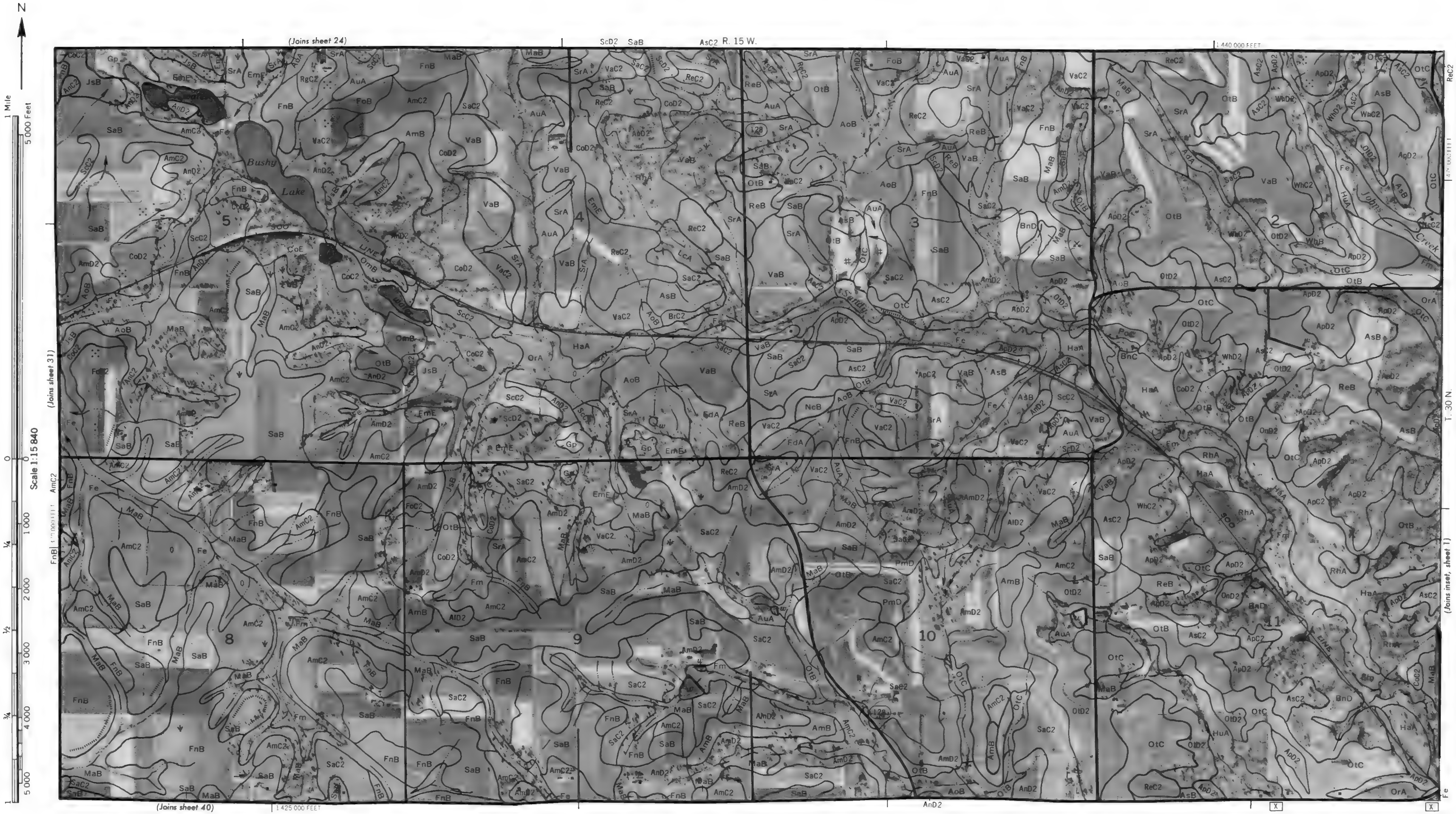
(Joins sheet 31)

T. 30 N.

1 385 000 FEET

475 000 FEET


1 405 000 FEET
R. 16 W.
R. 15 W.
T. 30 N.
(Joins sheet 23)
(Joins sheet 30)
(Joins sheet 32)
(Joins sheet 39)
Hudson
Scale 1:15 840
1 Mile
5 000 Feet


N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 24)
R. 15 W.
1 440 000 FEET
(Joins sheet 31)
T. 30 N.
(Joins inset, sheet 1)
(Joins sheet 40)
1 425 000 FEET
Bushy Lake
Johns Creek
5
4
3
2
8
9
10
11


R. 20 W.
R. 19 W.
(Joins sheet 25)
T. 30 N.
MINNESOTA
RIVER
COUNTY
WASHINGTON
SAINT
CROIX
Emmanuel Church
CEMETERY
SCHROEDER
QUARRY
14
13
18
22
23
24
19
(Joins sheet 34)
(Joins sheet 41)
1 296 000 FEET
1 Mile
5 000 Feet
Scale 1:15 840
N
33

34

N

(Joins sheet 26)

R 19 W.

1 315 000 FEET

470 000 FEET

T. 30 N.

(Joins sheet 33)

(Joins sheet 35)

(Joins sheet 42)

1 300 000 FEET

16 17 15 14 21 20 22 23

Bass Lake

Bright Lake

1 Mile 5 000 Feet

Scale 1:15 840

1 0 1 2 3 4 5 000


R. 19 W.
R. 18 W.
1 320 000 FEET
T. 30 N
(Joins sheet 27)
(Joins sheet 34)
(Joins sheet 36)
(Joins sheet 43)
1 335 000 FEET
13
18
17
16
24
19
20
21
NORTHWESTERN
CHICAGO
Boardman
Tenmile Creek
Scale 1:15 840
1 Mile
5 000 Feet


36
N
(Joins sheet 28)
(Joins sheet 35)
(Joins sheet 37)
(Joins sheet 44)
R. 18 W. R. 17 W.
T. 30 N.
1 360 000 FEET
465 000 FEET
460 000 FEET
1 340 000 FEET
1 Mile
5 000 Feet
Scale 1:15 840
0
1 000
2 000
3 000
4 000
5 000
1/4
1/2
3/4
15
14
13
18
22
23
24
19
Lund Pond
water


1 365 000 FEET
R. 17 W
(Joins sheet 29)
(Joins sheet 38)
(Joins sheet 36)
(Joins sheet 45)
1 380 000 FEET
460 000 FEET
T. 30 N
17
16
15
14
20
21
22
23
Erin Corners
St. Patricks Church
N
1 Mile
5 000 Feet
Scale 1:15 840

N

1 Mile

5 000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1

1 000 2 000 3 000 4 000 5 000

(Joins sheet 30)

R. 17 W. | R. 16 W.

1 400 000 FEET

469 000 FEET

460 000 FEET

1 385 000 FEET

T. 30 N.

(Joins sheet 37)

(Joins sheet 39)

(Joins sheet 46)

63

13 18 17 16

24 19 20 21

Creek Run Dry Run Creek

39

N

1 Mile

5 000 Feet

Scale 1:15 840

40

N

1 Mile

5 000 Feet

Scale 1:15 840

0 1 000 2 000 3 000 4 000 5 000

¼ ½ ¾ 1

(Joins sheet 32)

(Joins sheet 39)

(Joins sheet 48)

(Joins inset, sheet 1)

R. 15 W.

T. 30 N.

1 440 000 FEET

1 425 000 FEET

17 16 15 14

20 21 22 23

Glenwood City

ST. JOHNS CEMETERY

Tiffany Creek

6

128


41
N
1 Mile
5 000 Feet
Scale 1:15 840
1 000
2 000
3 000
4 000
5 000
1/4
1/2
3/4
1
0
1,280,000 FEET
460,000 FEET
R. 20 W.
R. 19 W.
T. 30 N.
(Joins sheet 33)
(Joins sheet 42)
(Joins sheet 49)
WASHINGTON
LAKE
SAINT CROIX
COUNTY
MINNESOTA
HOULTON CEMETERY
water
25
26
27
30
31
35
36

42

N

1 Mile

5 000 Feet

Scale 1:15 840

1 000 0 1 000 2 000 3 000 4 000 5 000

(Joins sheet 34)

R. 19 W.

1 315 000 FEET

T. 30 N.

(Joins sheet 41)

(Joins sheet 43)

(Joins sheet 50)

1 300 000 FEET

DaB

NcB

Perch Lake

Bass Lake

Lake

water

29 28 27 26 32 33 34 35

N

1 Mile 5 000 Feet

R. 19 W. | R. 18 W.

1 320 000 FEET

T. 30 N. 1 455 000 FEET

(Joins sheet 42)

(Joins sheet 35)

(Joins sheet 44)

(Joins sheet 51) 1 335 000 FEET

1 450 000 FEET

Scale 1:15 840

0 ¼ ½ ¾ 1

0 1 000 2 000 3 000 4 000 5 000

Boardman

Tamarack

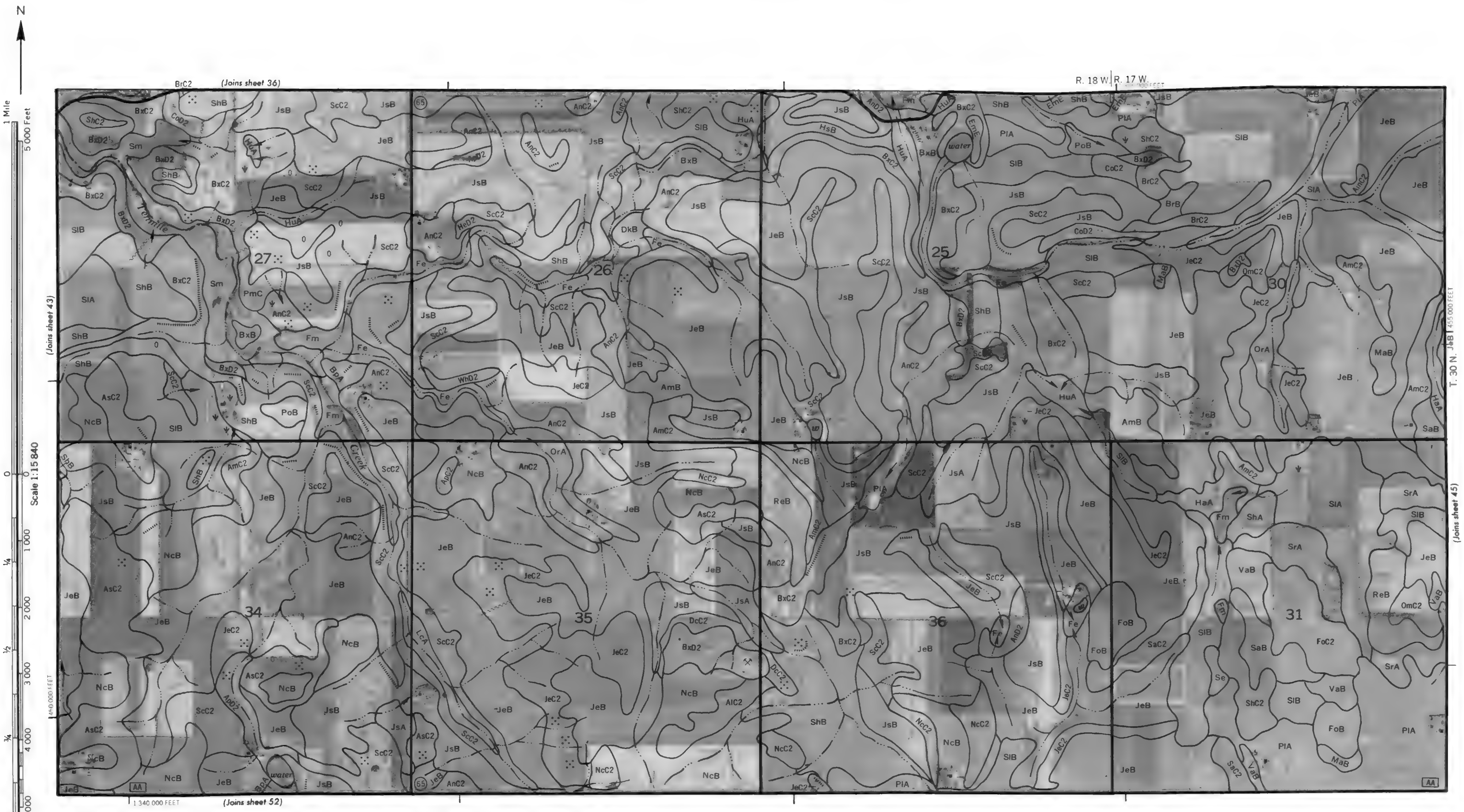
Willow

CHICAGO, MILWAUKEE, ST. PAUL & PACIFIC

NORTHWESTERN

25 30 29 28 36 31 32 33

ST. CROIX COUNTY, WISCONSIN — SHEET NUMBER 44



N

R. 17 W.

(Joins sheet 37)

1 360 000 FEET

T. 30 N.

(Joins sheet 44)

(Joins sheet 46)

29 28 27 26

32 33 34 35

Kinnickinnic River

Casey Lake

(Joins sheet 53)

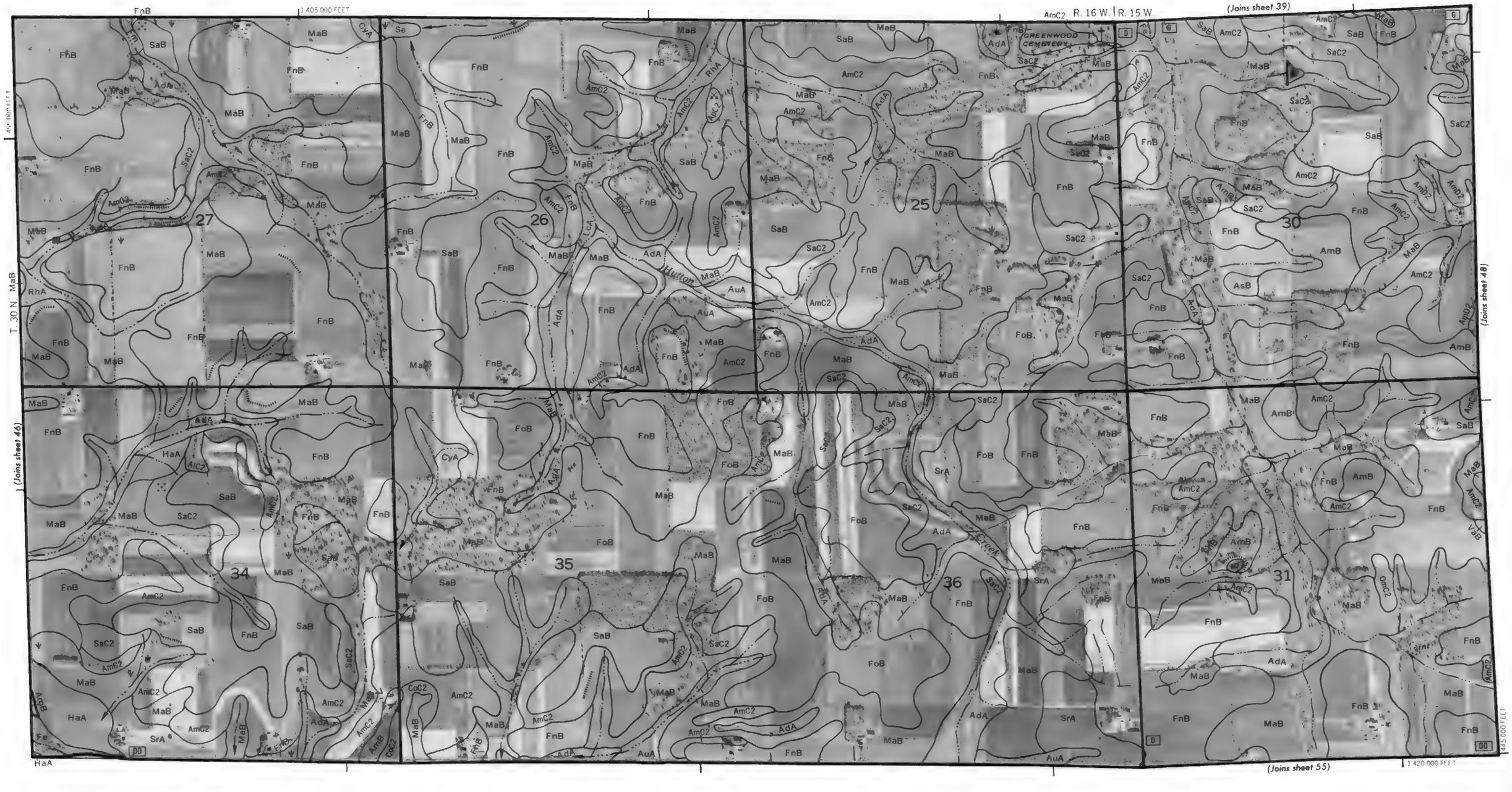
1 380 000 FEET

1 Mile

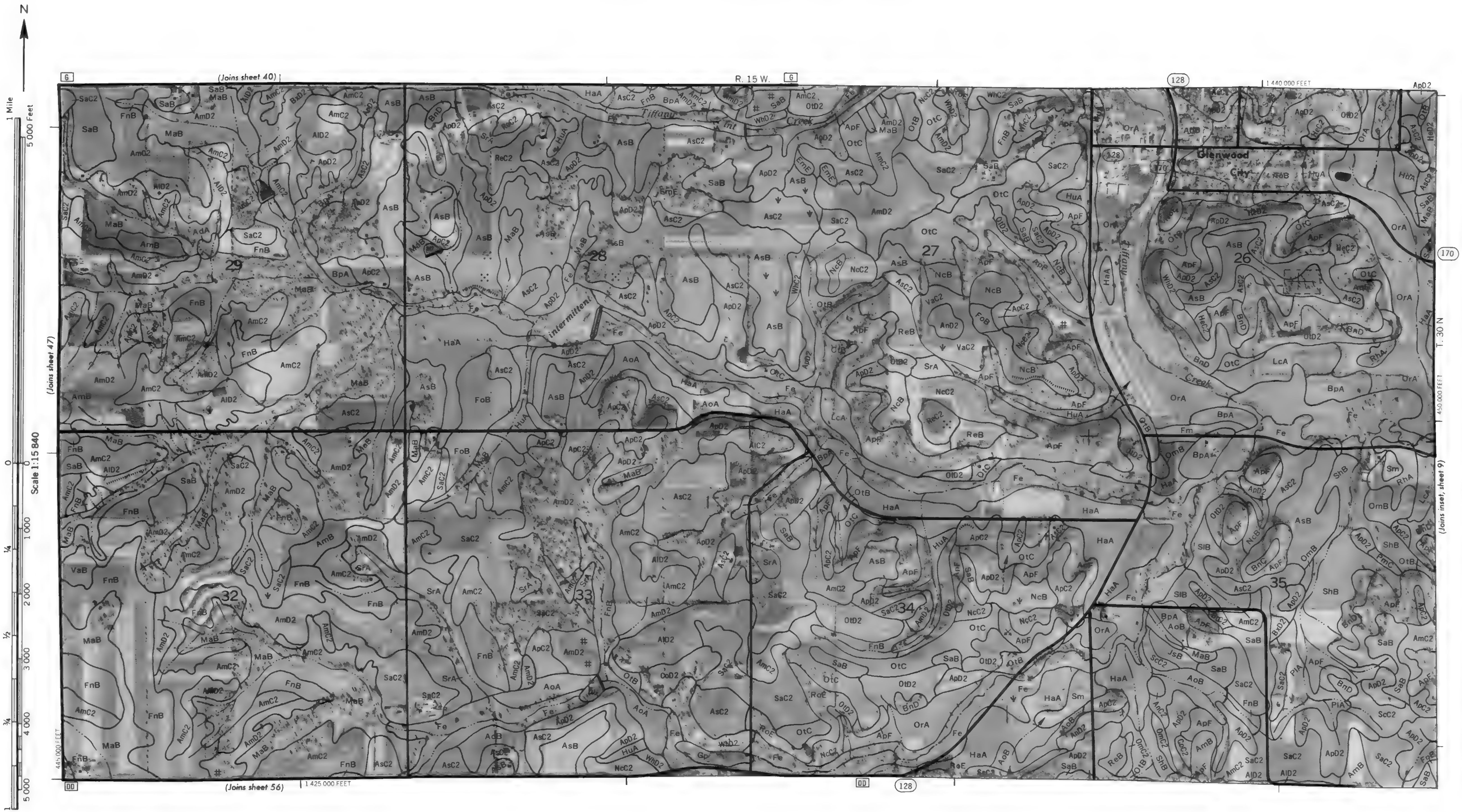
5 000 Feet

Scale 1:15 840


N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 38)
R. 17 W.
R. 16 W.
(Joins sheet 45)
(Joins sheet 47)
(Joins sheet 54)
T. 30 N.
25
29
30
28
36
31
32
33
Pine
Lake
Dry Run Creek
63
1 385 000 FEET
450 000 FEET
455 000 FEET
400 000 FEET


N
1 Mile
5 000 Feet
Scale 1:15 840
0
¼
½
¾
1 000
2 000
3 000
4 000
5 000
1 405 000 FEET
1 420 000 FEET
445 000 FEET
R. 16 W.
R. 15 W
T. 30 N.
(Joins sheet 39)
(Joins sheet 48)
(Joins sheet 46)
(Joins sheet 55)
GREENWOOD CEMETERY
Hutton Creek
27
26
25
30
34
35
36
31
FnB
MaB
SaB
SaC2
AmC2
AdA
AuA
RhA
HaA
FoB
SrA
AmB
AsB
OmC2
VaB

ST. CROIX COUNTY, WISCONSIN — SHEET NUMBER 48



N

(Joins inset, sheet 17)

R. 15 W.

1 445 000 FEET

410 000 FEET

T. 28 N.

(Joins sheet 80)

DUNN COUNTY

405 000 FEET

(Joins inset, sheet 65)

1 445 000 FEET

2000 AND 5000-FOOT GRID TICKS

1 285 000 FEET

450 000 FEET

T. 29 N.

R. 20 W.

R. 19 W.

(Joins sheet 41)

MINNESOTA

WASHINGTON COUNTY

LAKE SAINT CROIX

(Joins sheet 50)

440 000 FEET

(Joins sheet 57)

1 Mile

5 000 Feet

Scale 1:15 840

50

N

1 Mile

5 000 Feet

Scale 1:15 840

(Joins sheet 42)

R. 19 W.

1 315 000 FEET

T. 29 N.

(Joins sheet 49)

(Joins sheet 51)

(Joins sheet 58)

440 000 FEET

1 300 000 FEET

Mill Pond

Little Falls Pond

WILLOW RIVER STATE PARK

Willow River

NORTHWESTERN

CHICAGO AND

Burkhardt

5

4

3

2

8

9

10

11

N

R. 19 W. | R. 18 W.

1 320 000 FEET

T. 29 N.

445 000 FEET

(Joins sheet 43)

(Joins sheet 50)

(Joins sheet 52)

(Joins sheet 59)

440 000 FEET

1 Mile

5 000 Feet

Scale 1:15 840

0 1 000 2 000 3 000 4 000 5 000

52

N

R. 18 W. | R. 17 W.

1 355 000 FEET

(Joins sheet 44)

(Joins sheet 51)

(Joins sheet 53)

(Joins sheet 60)

T. 29 N.

440 000 FEET

1 340 000 FEET

1 Mile

5 000 Feet

Scale 1:15 840

0 0 ¼ ½ ¾ 1

1 000 2 000 3 000 4 000 5 000

Kinnickinnic River

N

1 Mile 5,000 Feet

Scale 1:15 840

0 0 ¼ 1 000 ½ 2 000 ¾ 4 000 1 5 000

1:360 000 FEET

445 000 FEET

T. 29 N.

R. 17 W.

(Joins sheet 45)

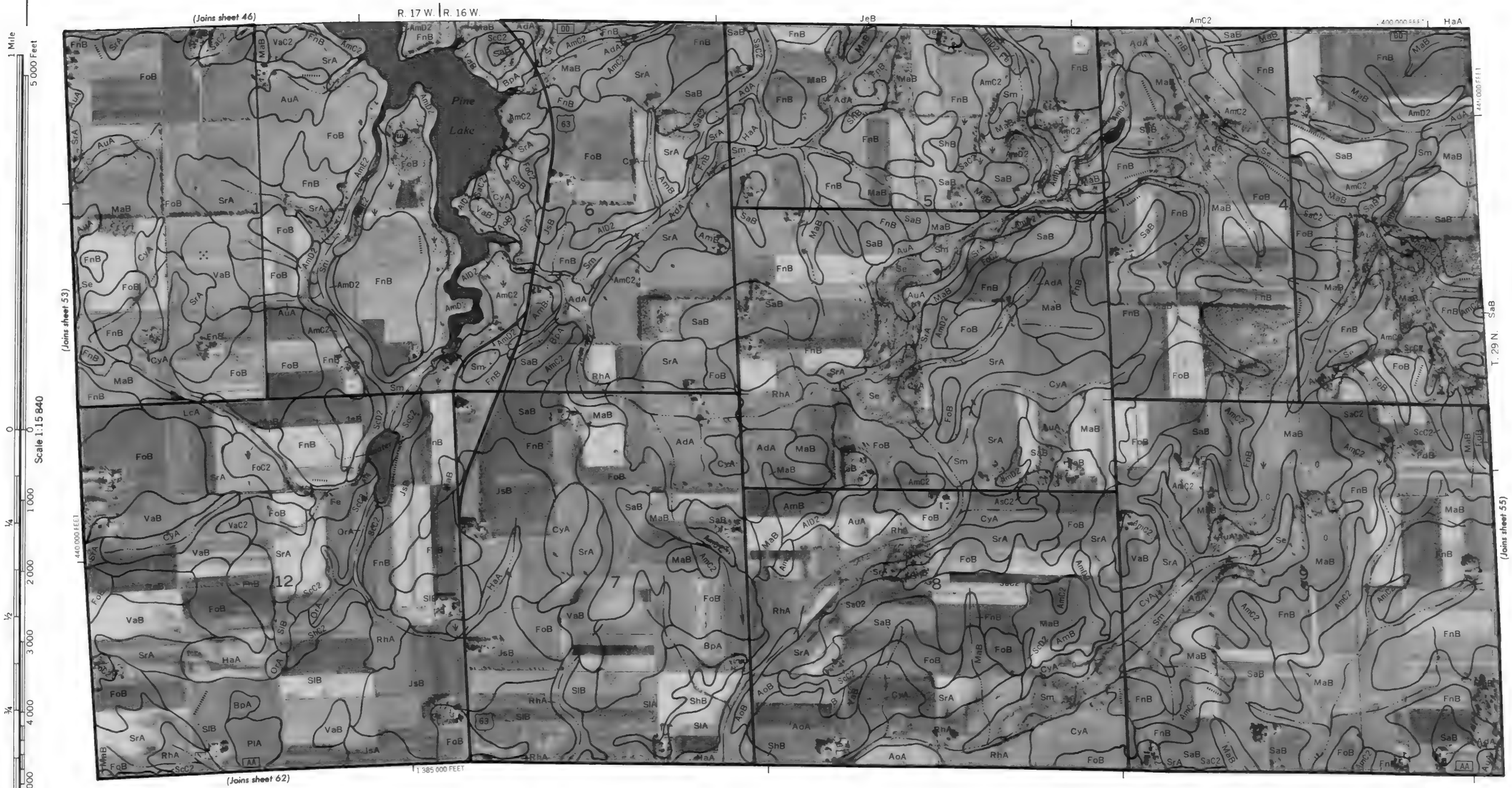
(Joins sheet 54)

(Joins sheet 52)

(Joins sheet 61)

1:360 000 FEET

MaB


54
N
1 Mile
5 000 Feet
Scale 1:15 840
0
¼
½
¾
1
1 000
2 000
3 000
4 000
5 000
(Joins sheet 46)
R. 17 W.
R. 16 W.
Pine Lake
(Joins sheet 53)
(Joins sheet 62)
(Joins sheet 55)
T. 29 N.
440 000 FEET
1 385 000 FEET
63
AA
BB
DD


55
N
(Joins sheet 47)
(Joins sheet 56)
(Joins sheet 63)
(Joins sheet 54)
R. 16 W. | R. 15 W.
T. 29 N.
1 405 000 FEET
1 420 000 FEET
435 000 FEET
Scale 1:15 840
1 Mile
5 000 Feet
Carr Creek
Eau Galle River
1
2
3
6
7
10
11
12

ST. CROIX COUNTY, WISCONSIN — SHEET NUMBER 56

56

N

1 Mile

5 000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1

1 000 2 000 3 000 4 000 5 000

R 15 W

1 440 000 FEET

T. 29 N.

(Joins sheet 48)

(Joins sheet 55)

(Joins sheet 64)

(Joins inset, sheet 9)

435 000 FEET

425 000 FEET

GLEN HILLS LAKE

GLEN HILLS COUNTY PARK

Beaver Creek

Beaver Creek

57

N

1 Mile

5,000 Feet

Scale 1:15 840

ST. CROIX COUNTY, WISCONSIN — SHEET NUMBER 58

59

N

R. 19 W. | R. 18 W.

(Joins sheet 51)

(Joins sheet 58)

(Joins sheet 60)

(Joins sheet 67)

T. 29 N.

1 320 000 FEET

1 335 000 FEET

435 000 FEET

430 000 FEET

CHICAGO AND NORTHWESTERN

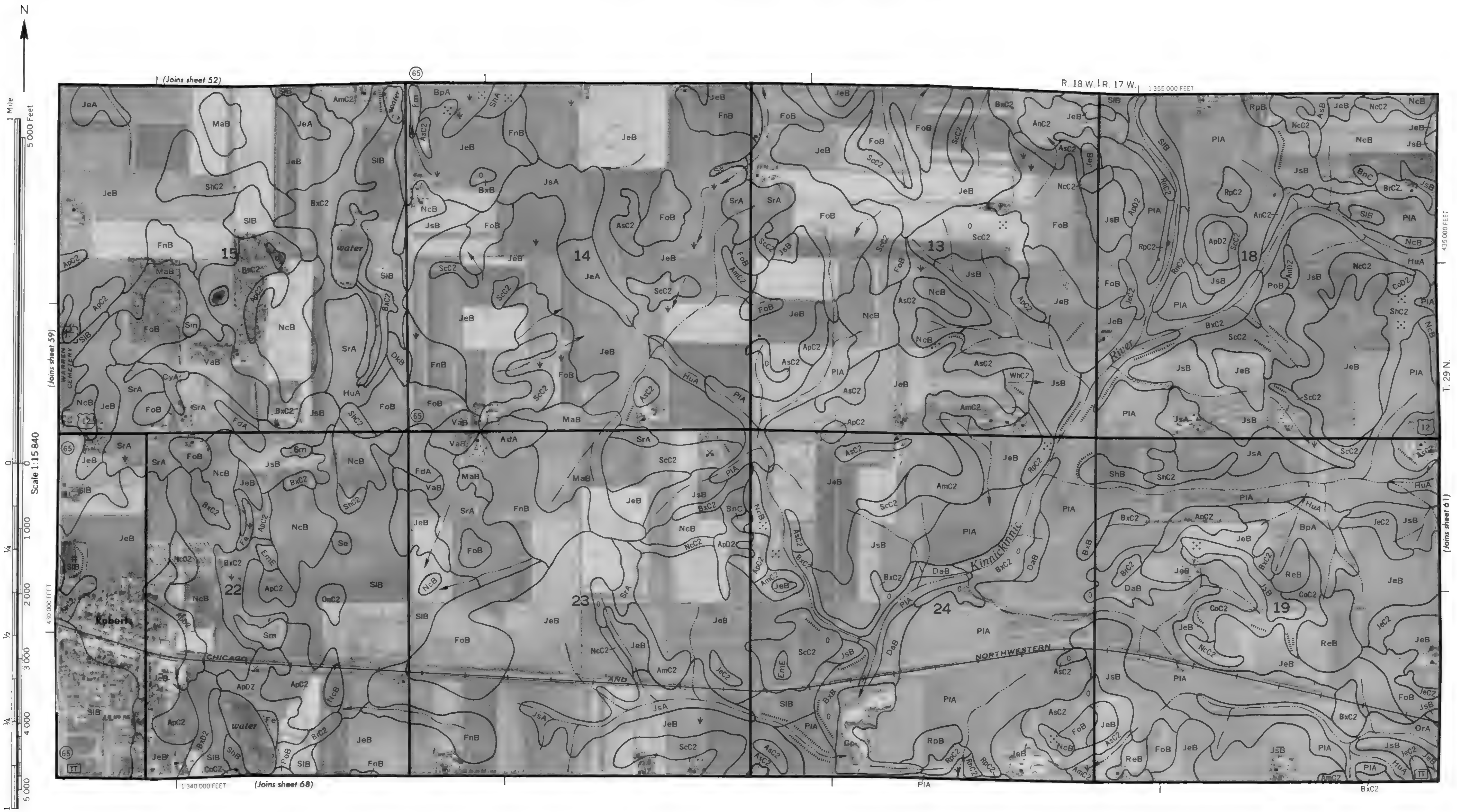
1 Mile

5,000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1

0 1 000 2 000 3 000 4 000 5 000


N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 52)
(Joins sheet 59)
(Joins sheet 61)
(Joins sheet 68)
R. 18 W. | R. 17 W.
T. 29 N.
1 355 000 FEET
435 000 FEET
430 000 FEET
1 340 000 FEET
15
14
13
18
22
23
24
19
Roberts
WARREN CEMETERY
River
Kinnickinnic
CHICAGO
AND
NORTHWESTERN
water

N

1 Mile

5 000 Feet

Scale 1:15 840

1 360 000 FEET

R. 17 W.

T. 29 N.

(Joins sheet 53)

(Joins sheet 60)

(Joins sheet 62)

(Joins sheet 69)

1 380 000 FEET

Hammond

16

15

14

17

20

21

22

23

62

N

1 Mile

5 000 Feet

Scale 1:15 840

R. 17 W. | R. 16 W.

T. 29 N.

(Joins sheet 54)

(Joins sheet 61)

(Joins sheet 70)

(Joins sheet 63)

1 400 000 FEET

435 000 FEET

430 000 FEET

Jehova Witness Church

Happy Valley Church

Faith Baptist Church

Christian Reform Church

Christian Reform School

Rush River

13 18 7 16 24 19 20 21

N

1 Mile

5 000 Feet

Scale 1:15 840

R. 16 W. | R. 15 W.

T. 29 N.

(Joins sheet 55)

(Joins sheet 64)

(Joins sheet 62)

(Joins sheet 71)

15 14 13 18

22 23 24 19

Emmanuel Lutheran Church

Creek

Calle

River

64

N

1 Mile

5 000 Feet

Scale 1:15 840

0 0 ¼ 1 000 ½ 2 000 ¾ 4 000 1 5 000

(Joins sheet 56)

R. 15 W

1 440 000 FEET

430 000 FEET

T. 29 N.

(Joins sheet 63)

425 000 FEET

(Joins sheet 72)

1 425 000 FEET

(Joins inset, sheet 17)

GLEN HILLS COUNTY PARK

16

15

14

20

21

22

23

128

Fe

SaB

65

N

R. 15 W.

(Joins inset, sheet 49)

1 443 000 FEET

400 000 FEET

T. 28 N

DUNN COUNTY

(Joins sheet 88)

(Joins inset, sheet 73)

1 445 000 FEET

2000 AND 5000-FOOT GRID TICKS

R. 20 W. R. 19 W

(Joins sheet 57)

1 285 000 FEET

T. 29 N

HUDSON

LAKE WASHINGTON

SAINT CROIX COUNTY

MINNESOTA

CATHOLIC CEMETERY

(Joins sheet 73)

1 295 000 FEET

(Joins sheet 66)

1 Mile

5 000 Feet

Scale 1:15 840

66

N

1 Mile

5 000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1

1 000 2 000 3 000 4 000 5 000

67

N

1 Mile

5 000 Feet

Scale 1:15 840

R. 19 W. | R. 18 W.

(Joins sheet 59)

T 29 N

(Joins sheet 66)

(Joins sheet 68)

(Joins sheet 75)

Twin Lakes

intermittent

Twin Lakes

water

25 30 29 28 36 31 32 33

94 65

1 335 000 FEET

14 000 FEET

68

N

1 Mile

5 000 Feet

Scale 1:15 840

R 18 W | R 17 W.

T 29 N.

(Joins sheet 60)

(Joins sheet 67)

(Joins sheet 69)

(Joins sheet 76)

420 000 FEET

1 340 000 FEET

Kinnickinnic River

South Branch Kinnickinnic River

27 26 25 30 34 35 36 31

N

1 Mile

5 000 Feet

Scale 1:15 840

1 360 000 FEET

R. 17 W

(Joins sheet 61)

T. 29 N.

425 000 FEET

(Joins sheet 68)

(Joins sheet 70)

(Joins sheet 77)

Hammond

CHICAGO AND NORTHWESTERN

South Branch Kinnickinnic River

Rush River

29 28 27 26 32 33 34 35

70

N

1 Mile
5 000 Feet
Scale 1:15 840
0
¼
½
¾
1
1 000
2 000
3 000
4 000
5 000

R. 17 W. | R. 16 W.

(Joins sheet 62)

1 400 000 FEET

420 000 FEET

T. 29 N.

(Joins sheet 69)

(Joins sheet 71)

(Joins sheet 78)

1 380 000 FEET

Baldwin Airport

BALDWIN CEMETERY

CHICAGO, ST. PAUL, MINNEAPOLIS AND OMAHA

CHICAGO, MILWAUKEE, ST. PAUL AND PACIFIC

CHICAGO, NORTH WESTERN

Rush River

25 30 29 28 36 31 32 33

63 12 BB


1 405 000 FEET
425 000 FEET
R. 16 W.
R. 15 W.
T. 29 N.
(Joins sheet 63)
(Joins sheet 70)
(Joins sheet 72)
(Joins sheet 79)
1 420 000 FEET
NORTHWESTERN
CHICAGO AND
Woodville
LONE PINE CEMETERY
Creek
Gulle
Eau
River
Scale 1:15 840
1 Mile
5 000 Feet
N

N

1 Mile 5 000 Feet

Scale 1:15 840

R. 15 W.

T. 29 N.

(Joins sheet 64)

(Joins sheet 71)

(Joins sheet 80)

(Joins inset, sheet 17)

1 440 000 FEET

1 435 000 FEET

1 430 000 FEET

1 425 000 FEET

415 000 FEET

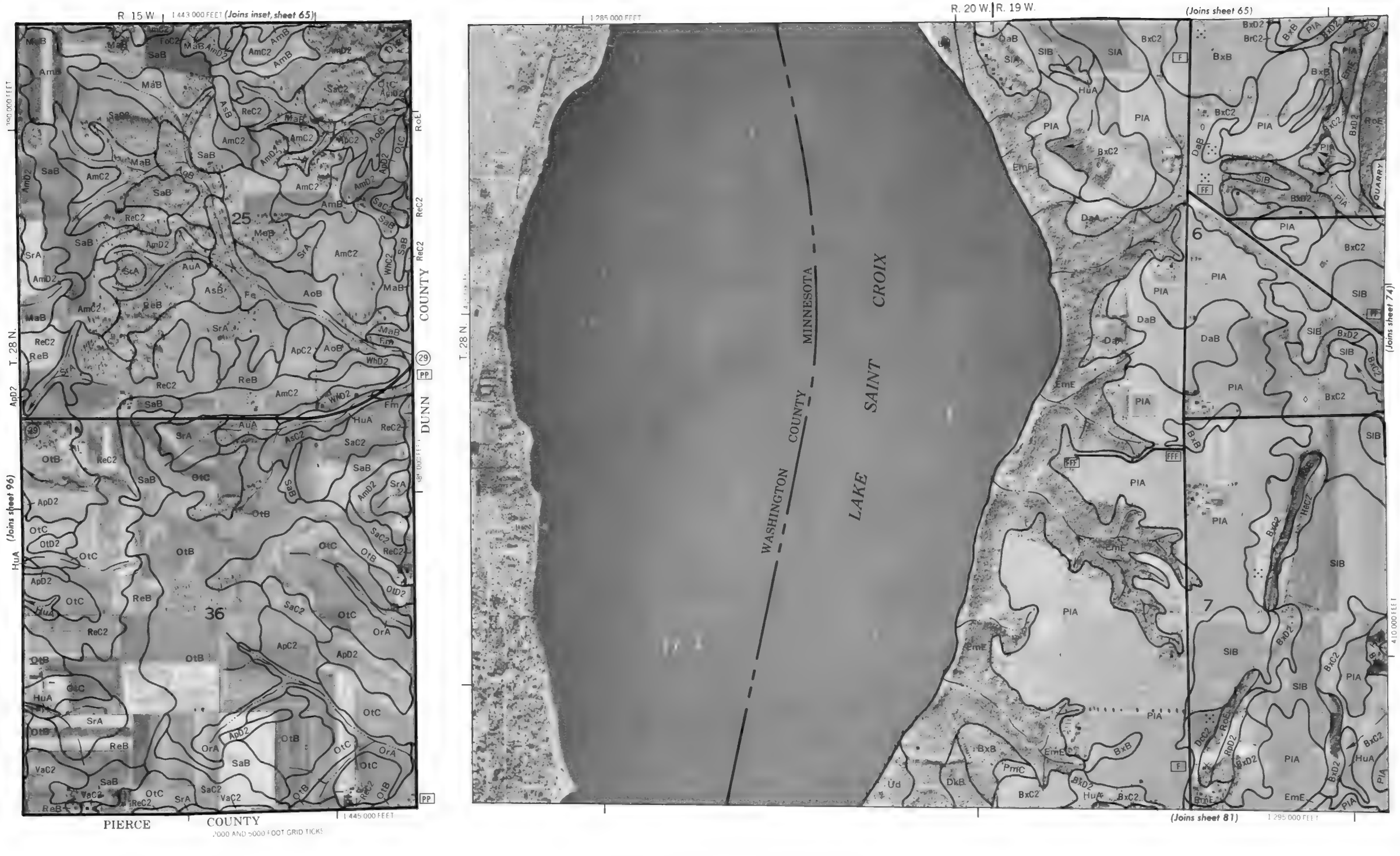
410 000 FEET

29 28 27 26 32 33 34 35

Hersey

Wilson

CHICAGO AND NORTHWESTERN


R. 15 W.
1 443 000 FEET
(Joins inset, sheet 65)
390 000 FEET
T. 28 N.
(Joins sheet 96)
HuA
25
36
29
28
PP
COUNTY
DUNN
PIERCE
COUNTY
2000 AND 5000 FOOT GRID TICKS
1 445 000 FEET
R. 20 W.
R. 19 W.
1 285 000 FEET
MINNESOTA
WASHINGTON COUNTY
SAINT CROIX
LAKE
(Joins sheet 65)
(Joins sheet 74)
(Joins sheet 81)
1 295 000 FEET
410 000 FEET
6
7
F
FF
FFF
QUARRY
N
1 Mile
5 000 Feet
Scale 1:15 840
0
1/4
1/2
3/4
1
1 000
2 000
3 000
4 000
5 000

74

N

1 Mile

5 000 Feet

Scale 1:15 840

(Joins sheet 66)

R. 19 W.

1 315 000 FEET

1 300 000 FEET

415 000 FEET

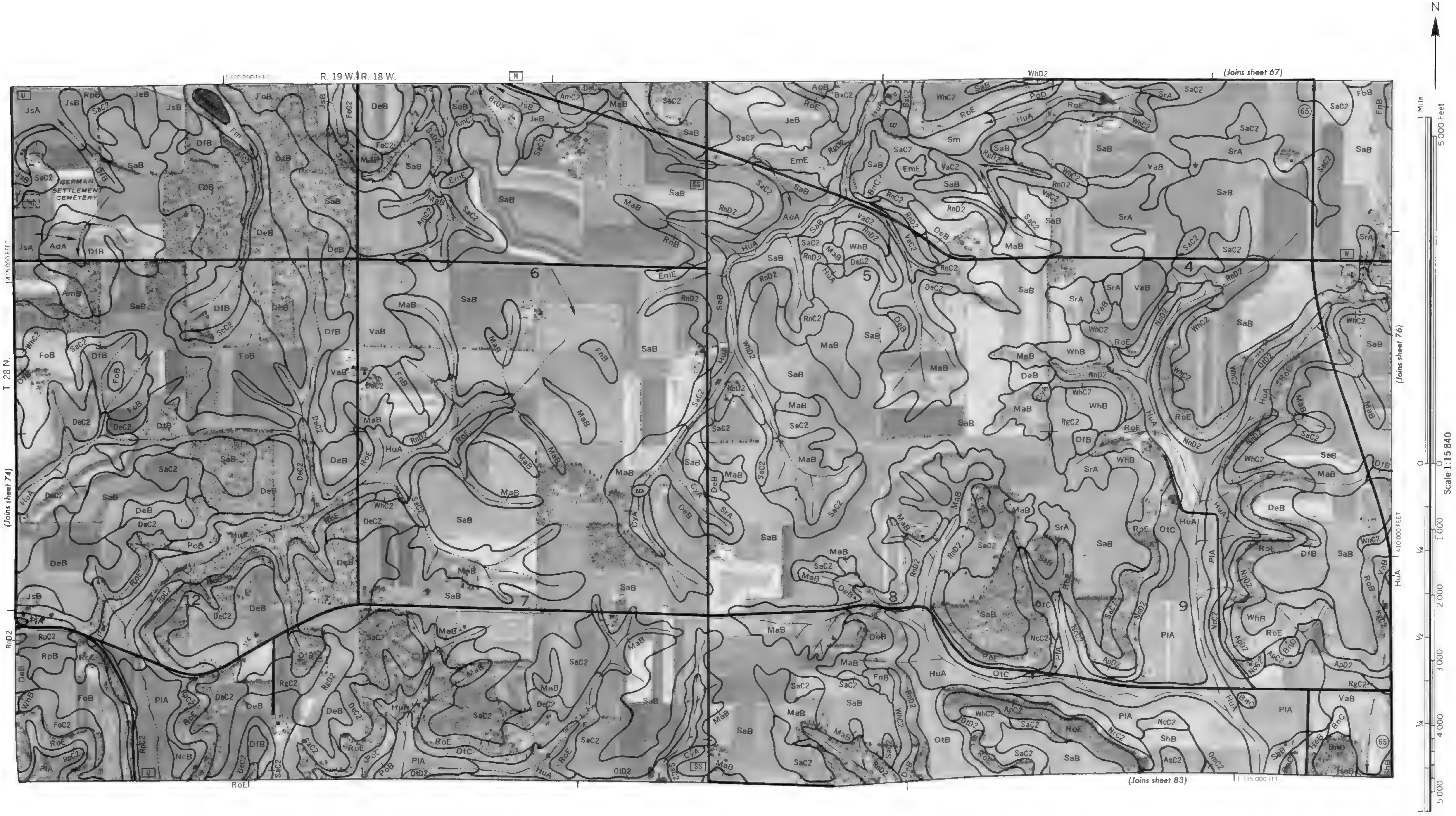
410 000 FEET

T. 28 N.

(Joins sheet 73)

(Joins sheet 75)

(Joins sheet 82)


N
R. 19 W. | R. 18 W.
(Joins sheet 67)
(Joins sheet 74)
(Joins sheet 76)
(Joins sheet 83)
T. 28 N.
GERMAN SETTLEMENT CEMETERY
6
5
4
7
8
9
12
1 Mile
5 000 Feet
Scale 1:15 840

ST. CROIX COUNTY, WISCONSIN — SHEET NUMBER 76

N

R. 17 W.

1 360 000 FEET

415 000 FEET

T. 28 N

(Joins sheet 69)

(Joins sheet 78)

(Joins sheet 76)

1 375 000 FEET

(Joins sheet 85)

1 Mile

5 000 Feet

Scale 1:15 840

0 0 1 000 2 000 3 000 4 000 5 000

78

N

1 Mile 5 000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1

1 000 2 000 3 000 4 000 5 000

R. 17 W. | R. 16 W.

T. 28 N.

1 395 000 FEET

410 000 FEET

1 385 000 FEET

(Joins sheet 70)

(Joins sheet 77)

(Joins sheet 79)

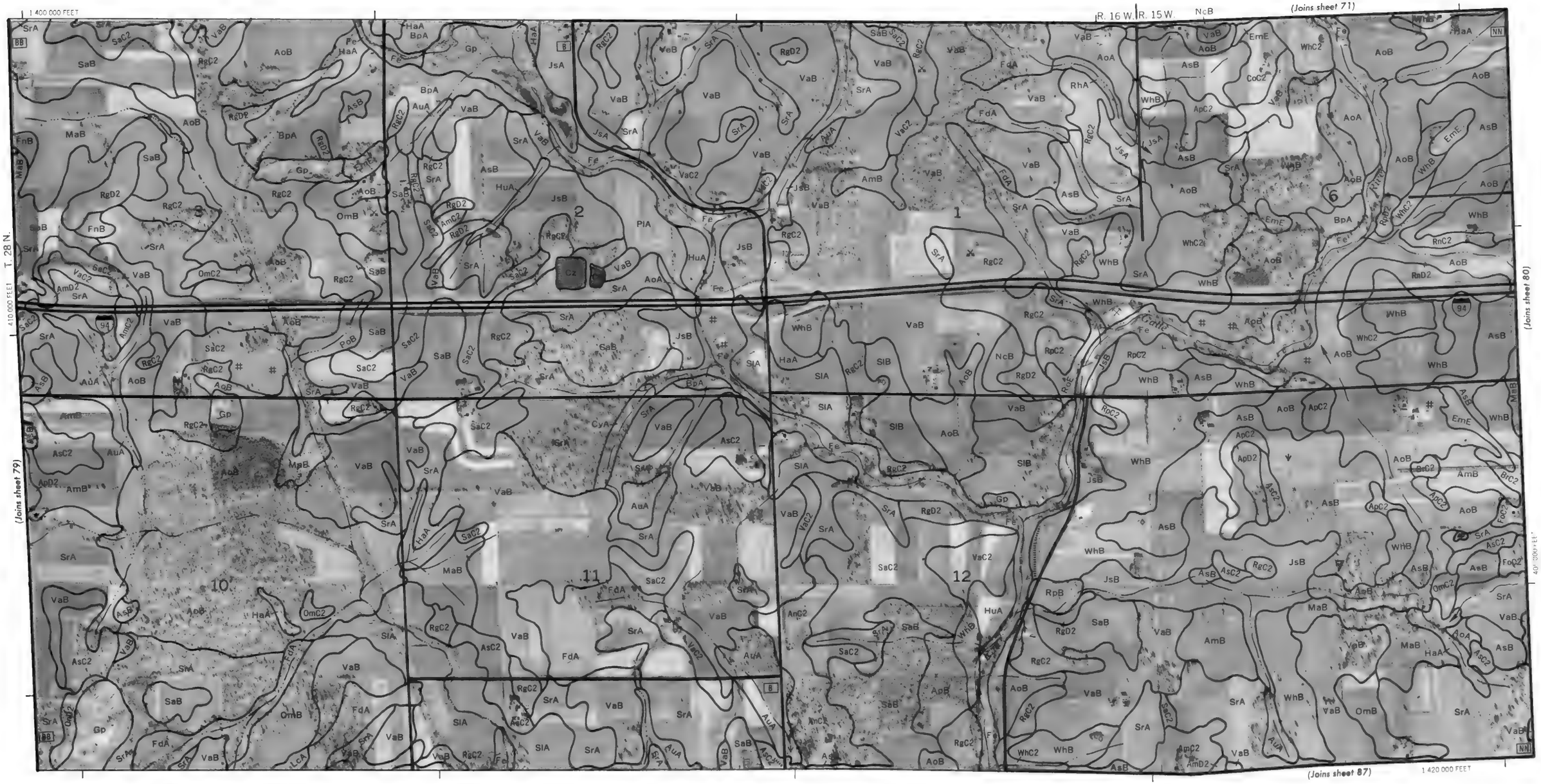
(Joins sheet 86)

Rush River

NORTH RUSH RIVER CEMETERY

6 5 4 12 7 9

63 83 94 BB GB



N

1 Mile

5 000 Feet

Scale 1:15 840

0 1/4 1/2 3/4 1

1 000 2 000 3 000 4 000 5 000

80

N

1 Mile

5,000 Feet

Scale 1:15 840

0 0 ¼ 1 000 ½ 2 000 ¾ 4 000 1 5 000

N

R. 20 W. | R. 19 W.

(Joins sheet 73)

1 275 000 FEET

400 000 FEET

T. 28 N.

MINNESOTA

WASHINGTON COUNTY

SAINT CROIX RIVER LAKE

ST. CROIX RIVER

Catfish Bay

13

24

18

19

(Joins sheet 82)

(Joins sheet 89)

1 Mile

5 000 Feet

Scale 1:15 840

82

N

1 Mile

5 000 Feet

Scale 1:15 840

0 0

¼ 1 000

2 000

½ 3 000

¾ 4 000

1 5 000

(Joins sheet 74)

R. 19 W.

(Joins sheet 81)

(Joins sheet 90)

(Joins sheet 83)

T. 28 N.

405 000 FEET

400 000 FEET

Glover

16

17

15

14

21

22

23

20

35

N

R. 19 W. | R. 18 W.

T. 28 N.

(Joins sheet 75)

(Joins sheet 82)

(Joins sheet 84)

(Joins sheet 91)

405 000 FEET

1 Mile

5 000 Feet

Scale 1:15 840

84

N

1 Mile

5,000 Feet

Scale 1:15 840

(Joins sheet 76)

(Joins sheet 83)

(Joins sheet 92)

(Joins sheet 85)

R. 18 W. | R. 17 W.

T. 28 N.

400,000 FEET

1,340,000 FEET

15

14

13

18

22

23

24

19

AFDAHL CEMETERY

N

1 Mile

5 000 Feet

Scale 1:15 840

0 0 ¼ 1 000 ½ 2 000 ¾ 3 000 1 4 000 5 000

1 360 000 FEET

405 000 FEET

R. 17 W.

T. 28 N.

(Joins sheet 77)

(Joins sheet 86)

(Joins sheet 84)

(Joins sheet 93)

1 375 000 FEET

395 000 FEET

17 16 15 14 20 21 22 23

River

Rush

86

N

1 Mile

5 000 Feet

Scale 1:15 840

R. 17 W. | R. 16 W.

T. 28 N.

Woodside Church

WOODSIDE CEMETERY

Rush

HuA River

(Joins sheet 78)

(Joins sheet 85)

(Joins sheet 94)

(Joins sheet 87)

1 395 000 FEET

1 380 000 FEET

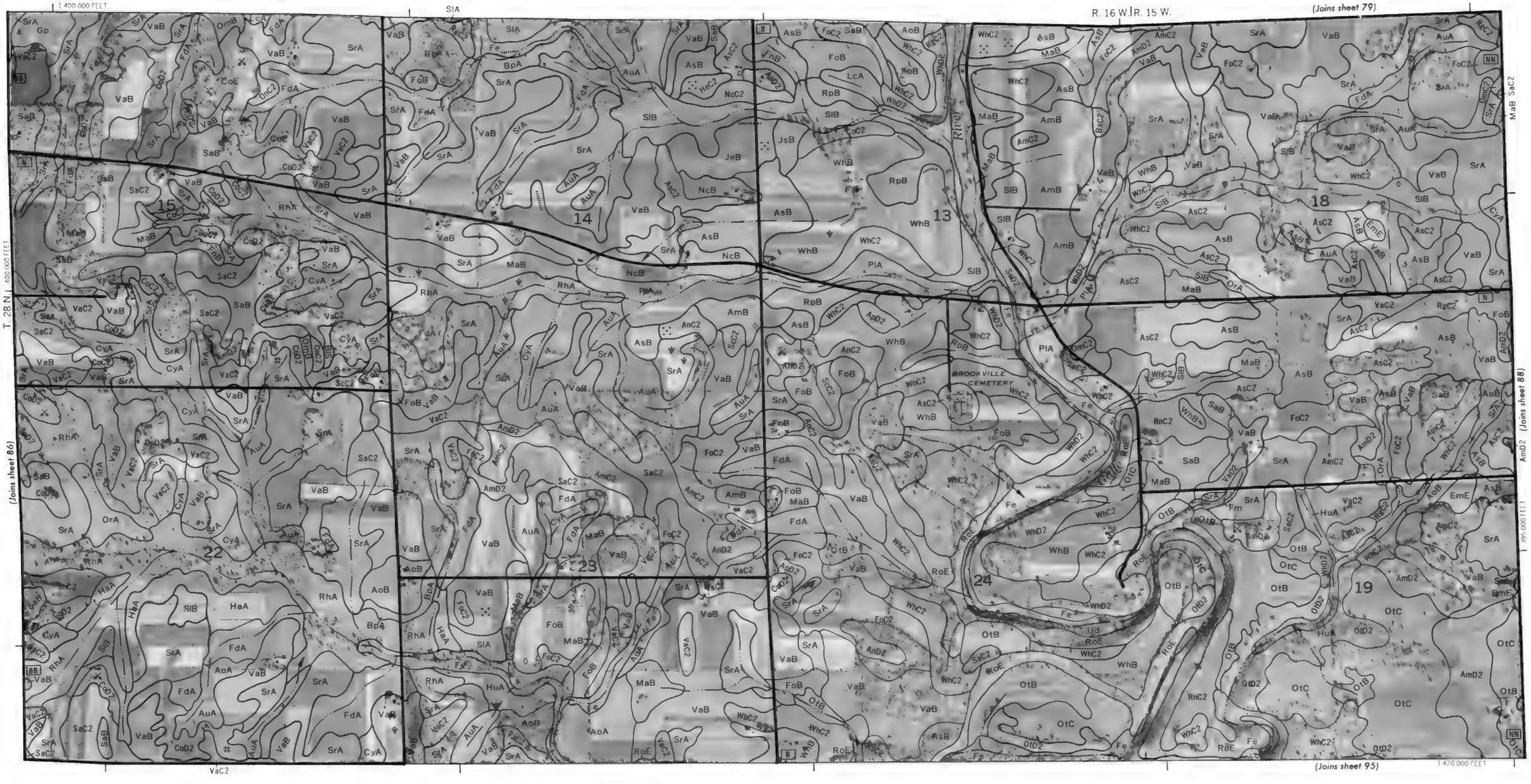
395 000 FEET

400 000 FEET

63

88

13 18 17 16 24 19 20 21



87

N

1 Mile

5 000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1

1 000 2 000 3 000 4 000 5 000

88

N

1 Mile

5 000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1

1 000 2 000 3 000 4 000 5 000

(Joins sheet 80)

R. 15 W.

1 440 000 FEET

400 000 FEET

T. 28 N.

(Joins sheet 87)

(Joins inset, sheet 65)

395 000 FEET

(Joins sheet 96)

1 425 000 FEET

N

R. 20 W. | R. 19 W.

(Joins sheet 81)

T. 28 N.

SAINT CROIX COUNTY, WISCONSIN — WASHINGTON RIVER

Black Bass Bar

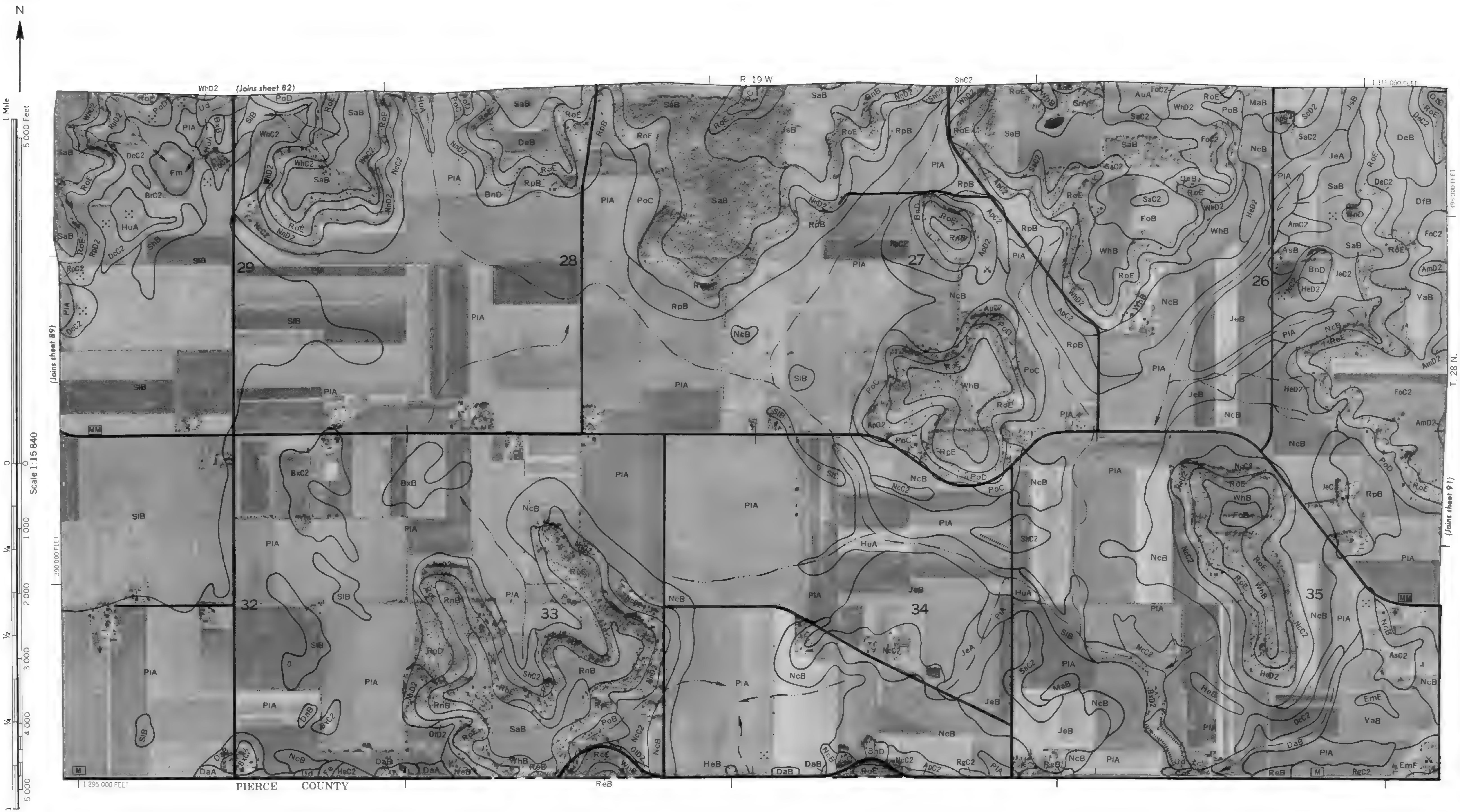
25 30 36 31

(Joins sheet 90)

PIERCE COUNTY

1 Mile 5 000 Feet

Scale 1:15 840


N
(Joins sheet 82)
R. 19 W.
T. 28 N.
(Joins sheet 89)
(Joins sheet 91)
29
28
27
26
32
33
34
35
PIERCE COUNTY
1 295 000 FEET
Scale 1:15 840
1 Mile
5 000 Feet
0
1/4
1/2
3/4
1 000
2 000
3 000
4 000
5 000

N

R. 19 W. | R. 18 W.

T. 28 N.

(Joins sheet 83)

(Joins sheet 90)

(Joins sheet 92)

RIVER FALLS

PIERCE COUNTY

1 Mile

5000 Feet

Scale 1:15 840

1:50 000 FEET

92

N

1 Mile

5 000 Feet

Scale 1:15 840

(Joins sheet 84)

(Joins sheet 91)

(Joins sheet 93)

R. 18 W. R. 17 W.

T. 28 N.

390 000 FEET

1 340 000 FEET

PIERCE COUNTY

93

N

1 Mile

5 000 Feet

Scale 1:15 840

1 360 000 FEET

395 000 FEET

R. 17 W.

(Joins sheet 85)

T. 28 N.

(Joins sheet 92)

(Joins sheet 94)

385 000 FEET

1 375 000 FEET

PIERCE COUNTY

94

N

1 Mile

5 000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1

1 000 2 000 3 000 4 000 5 000

R. 17 W. | R. 16 W.

(Joins sheet 86)

(Joins sheet 93)

(Joins sheet 95)

T. 28 N.

1 395 000 FEET

1 390 000 FEET

1 385 000 FEET

1 380 000 FEET

PIERCE COUNTY

N

1 Mile 5 000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1

1 000 2 000 3 000 4 000 5 000

1 400 000 FEET

390 000 FEET

385 000 FEET

1 415 000 FEET

T. 28 N.

R. 16 W. | R. 15 W.

(Joins sheet 87)

(Joins sheet 96)

(Joins sheet 94)

27 26 25 30 34 35 36 31

Gp

EAU GALLE RESERVOIR

Galle River

PIERCE COUNTY

96

N

1 Mile

5 000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1

1 000 2 000 3 000 4 000 5 000

R. 15 W.

T. 28 N.

1 440 000 FEET

390 000 FEET

385 000 FEET

1 420 000 FEET

(Joins sheet 88)

(Joins sheet 95)

(Joins inset, sheet 73)

PIERCE COUNTY

EAU GALLE RIVER

Lohn Creek

29 28 27 26 32 33 34 35